MANUAL

OF

NERVOUS DISEASES

AND

AN INTRODUCTION TO

MEDICAL ELECTRICITY.

BY

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PROF. OF DISEASES OF THE NERVOUS SYSTEM AND CLINICAL MEDICINE,
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PREFACE.

A long experience in clinical teaching has convinced me that the standard works on diseases of the nervous system are little suited to the wants of the beginner, who is not prepared to profit by the study of elaborate treatises. This conviction prompted the preparation of the present work, in which I have endeavored to present in a concise manner the established facts and current theories relating to nervous affections. To this end, in addition to the matter furnished by my own observations, I have freely used the most approved contributions to medical literature that deal with the subjects in hand.

The introductory chapter on the anatomy and physiology of the nervous system is particularly intended to draw the student's attention to the recent and important accessions to neurology. Much care has been bestowed on the subject of general symptomatology. A synopsis of the medical use of electricity seems to me not inappropriate in an elementary work that treats of a class of diseases in which this therapeutical agent is almost exclusively employed. Respecting the order in which the separate diseases are discussed, I preferred to retain the plan adopted in the annual course of lectures which I deliver in the College of Physicians and Surgeons, and which form the groundwork of this book.

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CHAPTER I.

THE ANATOMY AND PHYSIOLOGY OF THE NERVOUS SYSTEM.

The Structural Elements of a nerve consist of longitudinal white fibres, held together by a dense fibrous sheath (perineurium), which unites them into round or flattened cords. Each nerve fibre is separated from the rest by a thin sheath (neurilemma), and presents the appearance of a tube which contains medullary matter. In its centre there is a fine string, called the axis cylinder, which appears to be the essential element of a nerve fibre.

The Chemical Composition of nerve tissue is not well understood. The axis cylinder is probably an albuminoid substance; its medullary portion gives the reaction of fat.

The Non-medullated or Pale Fibres. These are of two kinds. Those presenting a non-medullated appearance throughout their whole course, as first pointed out by Remak, occur in the sympathetic and olfactory nerves. They are of a grey color, homogeneous, and flattened. The other variety is found in many nerves at their peripheral expansion, where they are deprived of the medullary substance and appear as naked axis cylinders. Although the nerve fibres are united into cords like threads in a skein of silk, they nowhere in their course anastomose or divide into branches.

Afferent and Efferent Nerves. A nerve which transmits an impression from the periphery to a nervous center is called an afferent or centripetal nerve, and one which carries an impulse in the opposite direction is called an efferent or centrifugal nerve. There is no specific difference between these two orders of nerves; the difference in function depends upon the character of the end-organ with which the several nerves are connected. A sensory nerve is obviously afferent or centripetal, for it conveys the stimulus from a peripheral to a central organ, where the stimulus may either be transformed into a conscious sensation (perception), or, stopping short of that,

excite a reflex center and initiate muscular movement. A motor nerve is always efferent, for it carries the impulse in a centrifugal direction, *i. e.* from a nervous center to a muscular organ, which responds by a contraction.

The Rapidity of Transmission of a sensory impression or of a motor impulse has been variously stated. It appears that the rate of conduction for both kinds of nerves is about thirty-four metres in a second.

Nerves of Common Sensation. Anatomical proofs are wanting that the different qualities of sensibility (tactile, painful, thermic sensations) depend upon distinct sets of sensory nerves. Pflüger maintains that the tactile and painful sensations are transmitted through the spinal cord by different channels.

Nerves of Special Sensation. Those cranial nerves which are connected with peripheral organs convey only the special impressions for which these structures are adapted. The retina is only excited by luminous rays; the basilar membrane of the cochlea of the ear by vibrations of the air; the olfactory epithelium by odorous particles. Nerves of special sensation, when under the influence of mechanical, chemical or electric excitation, invariably react in correspondence with the functions of the organs to which they are related. Irritation of the optic nerve is always followed by some visual symptom; that of the auditory by the perception of sound.

The Muscular Sense. Physiological considerations point to the existence of a muscular sense, which may be supposed to depend upon sensitive nerves intimately connected with muscular fibres. To carry out voluntary motor impulses, such as standing, walking, swimming, it is necessary that the mind be informed by definite sensations of the degree of effort which is required. Every voluntary strain or contraction of the muscles is attended by a sensation corresponding to the amount of energy which is put forth. It may therefore be said that the muscular sense has an educating influence.

The Nerve Cells. The structural elements of nerve cells or ganglion cells consist of a soft translucent substance and pigment granules, forming irregular or angular-shaped bodies, which send out from their circumference finely branched processes. According to the number of these processes, a cell is said to be uni-, bi- or mul-

tipolar. Each cell contains a round and well-defined nucleus in its interior, and, within this, one or more nucleoli. Nerve cells abound in the grey substance of the brain, the spinal cord, and in the sympathetic. They are also frequently found in the peripheral expansion of nerves.

The Functions of Nerve Cells. Nerve cells are the centers of nerve action wherever found in the animal organism; and since the brain and spinal cord are largely made up of such cells, these structures are considered the main centers of the nervous apparatus. The functional activities of the different nerve centers may be thus summarized: 1. *Automatic Action.* A nerve center excites a centrifugal impulse independent of an external influence. The respiratory movements and cardiac contractions are examples of automatic action. 2. *Reflex Action.* An impulse coming from a centripetal nerve produces an active state in the nervous center with which it is connected. This excites a motor or another kind of impulse which is conducted by a centrifugal nerve. The spinal cord may be considered a system of such reflex centers. 3. *Psychical Phenomena.* The active state of certain nerve centers is intimately related to mental manifestations—intelligence, volition, etc. These centers are also called "perceptive centers," and are located in the grey cortical substance of the brain.

The Spinal Cord.

The spinal cord is closely invested by the pia mater, and only loosely enveloped by the dura mater. The latter membrane is separated from the vertebral canal by venous plexus and areolar tissue; and from the pia mater by the arachnoid. Within the meshes of the arachnoid there is a fluid named the cerebro-spinal fluid. From the surface of the cord, the roots of the anterior and posterior spinal nerves emerge and pass out through the intervertebral foramina.

Two well-marked fissures run in a longitudinal direction along the cord, one in front and the other behind. They are named, respectively, the anterior median fissure and the posterior median fissure.

A transverse section of the cord presents two crescent-shaped masses occupying each lateral half, with their bases joined together in the middle by the grey or posterior commissure. This commissure is separated by a layer of white matter from the bottom of the

anterior fissure. Within the grey commissure the central canal runs through the whole length of the cord.

The prolongation of each crescentric body is named, according to its situation, the anterior cornu or horn, and the posterior cornu or horn; the anterior being more massive and shorter, the posterior more slender and longer. The narrower portion of the posterior horn near its continuation with the central grey substance, is called the cervix cornu; its enlargement behind is called the caput cornu posterioris. The grey matter at the tip of the caput cornu is distinguished as the gelatinous substance of Rolando. Another peculiarity of the grey matter is noticeable near the junction of the posterior horns where it presents a vesicular appearance. This is called Clarke's column.

The two anterior columns divided by the anterior median fissure are situated between the two anterior horns; the lateral columns, one on each side, occupy the space between the anterior and posterior horns; and the posterior columns, marked off by the posterior median fissure, run between the two posterior horns. A superficial furrow is recognized along each posterior column. The part on its inner side, principally in the cervical segment of the cord, is known as Goll's column.

The Ganglionic Nerve Cells of the Grey Substance are divisible into several groups according to their size and locality. Large cells preponderate in the cervical and lumbar enlargements, and in the anterior horns. Those of a medium size are mostly found in Clarke's column. The small cells prevail in the posterior horns and in the substance of Rolando; but large and small cells are found throughout both horns. Bundles of medullated nerve fibres run in every direction between these cellular elements.

The Connective Tissue.—Neuroglia.

The nerve elements of the spinal cord are closely united by an interstitial tissue throughout every part of the white and grey substances. This fine tissue or neuroglia contains nuclei and stellated bodies, resembling the cells of common connective tissue. They sometimes increase in number and size under pathological influences.

The Course and Communications of the Nerve Fibres in the Spinal Cord. Concerning the precise course of the nerve fibres proper to

the spinal cord, and the manner of their communication with the nerve cells, very little is as yet positively determined. The discovery of branched ganglion nerve cells is, however, of the highest importance, as it suggests a medium of connection between the two nerve elements. Valuable information has also been derived from pathological (Tuerk), and embryological (Flechsig), investigations concerning the anatomical relations of certain white tracks of the cord to definite parts of the brain. The numerous longitudinal fibres of the cord evidently point to a connection between different parts of this organ, and to their destination in the brain; but nothing definite is known respecting this anatomical arrangement. The same must be said of the multitude of horizontal and oblique fibres that traverse the spinal cord. Anatomical and physiological evidence establishes the fact that the motor fibres cross in the anterior pyramids, and continue in their new course. In regard to the direction of the fibres which enter the posterior nerve roots, it is rendered highly probable that they ascend to the brain through the funiculi cuneatus and gracilis, which form the continuation of the posterior columns (Burdach's column).

The Peripheral Expansion of Nerves. It is of great practical importance to become familiar with the peripheral distribution of the spinal nerves. Diseases of the cord frequently give rise to eccentric pains of a neuralgic or rheumatic character and other obscure affections.

The Functions of the Spinal Cord. The spinal cord is the only connecting link between the brain and the nerves of the trunk and extremities; and must, therefore, contain all the nerve-paths of the latter. Modern neuro-physiology dates its beginning from the great discovery of Charles Bell, namely, that the anterior nerve-roots of the spinal cord consist of motor, and the posterior nerve-roots of sensory, fibres. This physiological law has no exceptions.

In regard to the functions of the columns, it admits of no doubt that the anterior columns conduct motor impulses and the posterior sensory impressions. But the columns are not the direct prolongations of the nerve-roots. Irritation of the anterior columns is not followed by muscular movements, if their nerve-roots are left undisturbed; and in a similar manner no sensation is evoked from irritation of the posterior columns, if their nerve-roots are not involved. These observations led to the highly important distinction of æsthe-

sodic and kinæsodic substance. It appears that nerve tissue may be in a condition to transmit impulses, while it is itself incapable of being energetically acted upon by other modes of excitation—mechanical, chemical or electrical. Schiff has come to the following conclusions: The whole of the grey substance conducts sensibility. There is no exclusive relationship between certain parts of the grey substance and groups of sensitive nerves. Every portion of the grey substance transmits sensitive impressions. In section of the cord the less of the grey substance that remains, the less will be the transmission of sensibility. The grey substance itself is not sensitive, but easily transmits sensitive impressions (æsthesodic). An analogous explanation is applicable to transmission of motor impulses. A stimulus directed to the grey substance readily conducts an impulse to motor nerves (kinæsodic). Charles Bell was of the opinion that the lateral columns innervated the muscles of respiration, but physiological and pathological facts speak against it. That the lateral columns stand in intimate relation to the transmission of motor impulses there can be no doubt.

The Spinal Cord a Center of Reflex Action. All sensitive nerves, the sympathetic as well as the spinal, are capable of exciting reflex action, and every muscle is subject to its influence. Reflex action consists essentially in the transmutation of one kind of nerve action into another kind. Its mechanism requires a centripetal nerve connected with a central nerve cell from which a centrifugal nerve goes to a muscle or irritable tissue. The anatomical construction and relations of the spinal cord completely answer such a purpose. Suppose a sensitive nerve in some part of the skin be irritated, the nervous stimulation thus induced travels to a ganglionic nerve cell in the spinal cord, and by an unknown process is there transmuted into an impulse which is propagated by a motor nerve connected with a muscle. The muscular movement which now ensues is the result of reflex action. Such a movement may be unilateral, symmetrical, regular or disorderly, according to the direction and intensity of the initiatory irritation, and the number of implicated motor centers. If reflex action involves the general muscular system, as in tetanus and epilepsy, it must be assumed on physiological grounds that motor centers in the medulla oblongata are excited. Anæsthetics, but especially the application of powerful stimuli to the skin, diminish reflex excitability. It is increased in the inactive state of the brain

during sleep, in strychnine poisoning, and in pathological conditions of the meninges. It is diminished or abolished in lesions of the lumbar region of the cord and by powerful cutaneous impressions.

Inhibitory Function of the Spinal Cord. There are other influences which are capable of retarding and even of checking reflex movements. We know that by an effort of the will we can sometimes control the reflex acts of coughing and sneezing, and by a volitional exertion are able to restrain, *i. e.* inhibit, the movements of our limbs when they are tickled. By inhibition, therefore, is meant the fact of impeded reflex action. Setschenow and others who have experimented on frogs for the purpose of determining the anatomical basis of these phenomena, came to the conclusion that "inhibitory centers" exist in certain parts of the brain and the spinal cord, which moderate reflex action. Whether such centers exist or not in the human subject, the fact remains that under certain circumstances an inhibitory influence is exerted on the functions of the spinal cord.

The Spinal Cord a Center of Co-ordination. Voluntary muscular movements require a complex mechanism, by which groups of muscles that are sometimes widely apart from each other act together for the accomplishment of a definite purpose. Take for example the act of walking; although the will gives the initiatory motor impulse, yet it has nothing to do with the selection and regulation involved in the play of muscles which must be brought into action. In fact the mind would be overwhelmed in making the attempt. Moreover, co-ordinate muscular movements also take place independently of volition. A brainless frog is still able to exhibit co-ordinate movements when parts of its body are irritated. Looking at the reflex apparatus in the spinal cord, it is not difficult to understand how such movements in the mutilated animal are brought about. It may be conceived that groups of nerve cells are arranged in such a way that in response to a sensory irritation, a motor impulse is excited, which acts upon muscles or groups of muscles that usually perform associate movements. Incoördination resulting from disease of the posterior columns of the cord, may be thus ascribed to the failure of peripheral stimulation to reach centers of co-ordination. There is, however, strong evidence to show that the spinal cord is not the primary organ of co-ordination. A frog whose brain is divided below the pons is still able to breathe, and to move his legs when they are irritated; but he cannot perform the complicated movements of

jumping and swimming; and when he is laid upon his back he cannot turn himself upon his feet. The centers of automatic action which, independent of the will, regulate a variety of complicated movements, are unmistakably located in the medulla oblongata; and pathological investigations as well as physiological experiments have traced centers of co-ordination to the corpora quadrigemina, the cerebellum and the pons varolii.

Trophic Influence of the Spinal Cord upon Peripheral Nerves.— Recent investigations tend to sustain the opinion that the grey substance of the spinal cord exercises an influence upon the nutrition of muscles. Degeneration and atrophy of muscles appear to be caused by destruction of ganglionic cells in the grey substance of the anterior horns. Such a lesion has been discovered in progressive muscular atrophy, in glosso-labio-pharyngeal paralysis, and in the spinal paralysis of children.

The Influence of the Spinal Cord upon Involuntary Muscles.

The Oculo-Spinal Center. Irritation of the anterior roots of the second and third cervical nerves, and of that portion of the spinal cord included between the sixth cervical and third dorsal nerves, produces dilatation of the pupils. On dividing the connection between this pupillary center and the sympathetic, contraction of the pupils takes place.

The Genito-Urinary Center. Injury of the spinal cord is sometimes followed by erection and ejaculations. In the squirrel there is a center in the lumbar region of the cord which, on being irritated, causes priapism. Irritation of the third and fourth sacral and fifth and sixth lumbar nerves produces contraction of the bladder in this animal.

The Sphincters. The spinal cord exerts an important influence upon the functional integrity of the sphincters. The nerves of the bladder come from the lumbar region of the cord. The sensitive fibres are derived from the sympathetic, the motor fibres are distributed to the detrusor muscle. Contraction of the bladder is a reflex act. Excitation of the sympathetic alone does not cause the expulsion of urine; this requires the connection of the bladder with the spinal cord through the medium of an excito-motor mechanism.

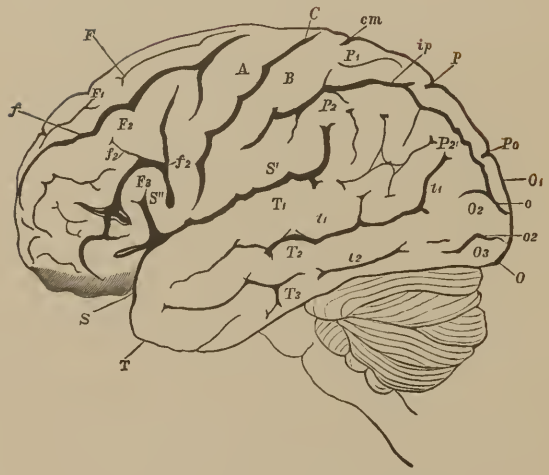

FIG. 1.—SIDE VIEW OF THE HUMAN BRAIN.

F Frontal lobe.
P Parietal lobe.
O Occipital lobe.
T Temporal lobe.
S Fissure of Sylvius.
S′ Horizontal.
S″ Ascending branch.
C Central fissure (Fissure of Rolando.)
A Ascending frontal convolution.
B Ascending parietal convolution.
F_1, F_2, F_3, Superior, middle, inferior frontal convolution.
f_1, f_2, f_3, Superior, inferior, vertical frontal fissure (precentral *F*).
P_1 Superior parietal lobule.
P_2 Inferior parietal lobule (Gyrus supramarginalis).
P_2' Gyrus angularis.
ip Interparietal sulcus.
cm Extremity of the Sulcus calloso marginalis.
O_1, O_2, O_3, First, second, third occipital convolution.
Po Fissura parieto-occipitalis.
o Transverse occipital fissure.
o_2 Sulcus occipitalis longitudinales inferior.
T_1, T_2, T_3, First, second, third temporal convolution.
t_1, t_2, First, second temporal fissure (Ecker).

The regulation of the sphincter does not entirely depend upon its direct connection with the lumbar nerves, as disturbances of the function of the bladder are also caused by lesions of the cervical and dorsal regions of the spinal cord.

The Brain.

The lobes of the cerebral hemispheres are named in accordance with the respective cranial bones that cover them. They comprise the frontal, parietal, temporal, and occipital lobes.

The Fissures or Sulci. The surface of each hemisphere is marked by furrows that run in different directions, seemingly without any fixed order. But on comparing the brains of different species of mammals, fissures of an analogous description can be recognized which are constant. These fissures mark the boundaries of the convolutions.

The Fissure of Sylvius. This is the most constant of all the fissures, and is already developed in the third month of embryonic life. It commences on the under surface of the brain, and is formed by the folding of the whole hemisphere downwards, like an arch around the crura cerebri. This fissure divides into two branches—a short anterior branch which ascends towards the frontal lobe, and a long posterior branch which takes a horizontal course in the direction of the parietal lobe. At its bifurcation it forms a fossa, in which the insula of Reil is situated, covered by the operculum.

The Central Fissure, or the *Fissure of Rolando*, runs in a nearly vertical direction from the upper margin of the hemisphere towards the posterior division of the Sylvian fissure.

The Intro-parietal Fissure begins at the angle formed by the central fissure and the posterior branch of the Sylvian, and passes backward in the direction of the parieto-occipital fissure.

The Parieto-Occipital Fissure is composed of a median and a lateral part. Its median portion is constant and deep, and divides the parietal from the occipital lobe. The lateral portion is short, but sometimes it extends in an oblique direction over a considerable part of the hemisphere.

The Fissures of the Median Side of the Hemispheres. The principal fissures in this region comprise the sulcus calloso-marginalis,

which runs for a short distance from the upper margin of the hemisphere in a vertical direction, then making a turn, runs parallel with the corpus callosum. The calcarian fissure is formed by the junction of two small furrows and takes a horizontal direction. The superior extremity of the central fissure extends a little way to the median side.

The Fissures of the Inferior Surface of the brain are mostly the continuations of the sulci that have already been described, and will be again mentioned in connection with the convolutions of which they form the boundaries.

The Convolutions.

Convolutions of the Frontal Lobe. The frontal lobe is bounded on its superior and lateral sides by the fissure of Rolando, which divides it from the parietal lobe; on the inferior side by the vertical branch of the Sylvian fissure and the substantia perforata, that divides it from the temporal lobe. There is no marked line of division on the median side between the frontal and temporal lobes.

The Ascending Frontal Convolution. This convolution runs upward in front of the central fissure and unites at both ends with the convolution on the opposite side of this fissure. These two convolutions are usually spoken of as the "central convolutions."

The Superior or First Frontal Convolution. This convolution starts from the upper portion of the ascending frontal, and runs forward where a number of irregular furrows subdivide it into minor elevations. Its median portion is bounded by the calcarian fissure. Its narrow extremity on the inferior surface of the frontal lobe is called the gyrus rectus.

The Middle or Second Frontal Convolution. This convolution is a continuation of the upper end of the first convolution, and runs forward where it subdivides into a number of complicated elevations. Inferiorily it fills the orbital fossa.

The Inferior or Third Frontal Convolution. This convolution is a prolongation of the lower portion of the central, and forms a part of the operculum. From there it winds around the vertical branch of the Sylvian fissure, and going forward and then downward, forms the lateral aspect of the frontal lobe (Broca's convolution).

Convolutions of the Parietal Lobe. The parietal lobe is separated in its superior aspect from the frontal lobe by the central fissure; from the temporal lobe by the Sylvian fissure, and imperfectly from the occipital lobe by the parieto-occipital fissure. The calloso-marginalis fissure forms a complete boundary on the median side between the parietal and the occipital lobes.

The Ascending Parietal Convolution. This convolution runs parallel with the ascending frontal on the posterior side of the central fissure. The first and second parietal convolutions (posterior and inferior parietal lobules) run backward from the ascending convolution and are separated by the intraparietal fissure. They are marked by numerous narrow furrows which divide and subdivide them into small elevations.

The Praecunial Convolution (Quadrate Lobule). This convolution is a prolongation of the superior portion of the ascending parietal convolution. After curving backward it enlarges and forms a square-shaped lobule, which is composed of a number of minor convolutions. It extends to the parieto-occipital fissure, which completely separates it from the first occipital convolution (cuneus). On the median side it is sharply defined by the calloso-marginal fissure.

The Third Parietal Convolution. This is an exceedingly complicated and ill-defined convolution. It is usually divided into an anterior and posterior portion. The former is also called the lobulus supra-marginalis, and is situated between the lower end of the ascending parietal convolution and the upper extremity of the Sylvian fissure. It forms there a part of the operculum, and presents several lobules that curve around the end of the fissure, and terminates in the first temporal convolution. The posterior portion, or the gyrus angularis, is bounded above by the intraparietal fissure, unites with the occipital lobe, and then, in the form of an arch, folds around the first temporal fissure, where it unites with the second temporal convolution.

The Convolutions of the Temporal Lobe. The temporal lobe fills the sphenoidal fossa and forms the smallest portion of the hemisphere. It presents only two sides, a lateral and an inferior. The Sylvian fissure divides this lobe from the whole of the frontal and partly from the parietal lobe; but on its inferior surface it can hardly be distinguished from the posterior portion of the parietal

and from the occipital lobes. Hence it is convenient to consider the under surface of both lobes as the occipito-temporal lobe. The convolutions of the temporal lobe are also very complicated on account of the extreme variableness of its fissures. A rather constant fissure, running parallel with the Sylvian, encloses the gyrus infra-marginalis (first temporal convolution), which, folding around the upper end of the latter fissure, is lost in the supra-marginal convolution. The middle or second temporal convolution has for its upper boundary the first temporal convolution, and posteriorly the angular gyrus; but on its inferior side it unites, to a great extent, with the third temporal convolution.

Convolutions of the Occipital Lobe. As the calcarian and the parieto-occipital fissures form an acute angle on the median surface of the hemisphere, a triangular, or rather a wedge-shaped portion of the brain is thus cut off, with its base directed upward and backward, and its apex downward and forward. This is the cuneiform convolution, or the internal occipital lobule. The portion of the occipital lobe below this convolution cannot be distinguished from the contiguous convolution of the temporal lobe. The inconstant and "bridging" convolutions on the superior and lateral aspects of the occipital lobe, render their description an extremely difficult task. Authors distinguish, however, a superior, middle, and an inferior occipital convolution.

The Convolutions of the Base of the Brain. These convolutions posterior to the fissure of Sylvius, belong partly to the temporal and partly to the occipital lobe. The former is marked by a deep and constant fissure which divides it into two convolutions,—the lingualis and the fusiform lobules. The occipito-temporal convolution, as its name indicates, is formed by the union of outer portions of the temporal and occipital lobes. All the convolutions in this region of the base of the brain run in a horizontal direction.

The Convolutions of the Median Surface of the Brain. Most of these convolutions have already been described. The gyrus fornicatus is the most conspicuous convolution on the median side of the hemispheres. It is bounded above by the calloso-marginalis fissure and winds around the corpus callosum. Toward its posterior extremity it becomes narrow, turns downward and forms the gyrus hippocampi.

The foregoing is but a meagre account of the labyrinth of

THE MONKEY BRAIN.

(*Cerocebus cinomolgus.*)

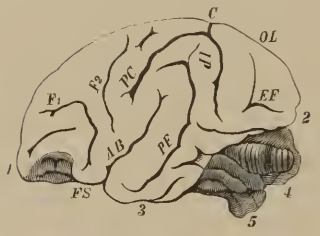

FIG. 2.

1 Inferior extremity of the forehead.
2 Inferior extremity of the occiput.
3 Inferior extremity of the temple.
4 Cerebellum.
5 Medulla oblongata.
FS Fissure of Sylvius.
AB Posterior or ascending branch.
C Central fissure (Fissure of Rolando).
F_1 Inferior frontal fissure.
F_2 Superior frontal fissure.
PC Paracentral fissure.
IP Interparietal fissure.
PF Parallel fissure.
EF External occipital fissure (monkey fissure).
OL Occipital lobe (Meynert).

convolutions presented by the human brain. To overcome some of the difficulties in studying this complex anatomical arrangement, it is advisable to compare the simple conformation of the cerebral surface in the monkey, with that of the human brain.

The Cortex. Histologists distinguish five layers of nerve cells in the cortex. The cells are of various shapes and sizes. Some are branched, others are pyramidal, oval or irregular. Many of them occur in groups separated by bundles of radiating nerve fibres.

Physiology reaches its limits when it assigns to the cortical substance of the hemispheres the highest position in the order of reflex apparatus whose operations are associated with consciousness. The following considerations point to the intimate relation existing between the cortex and the manifestations of intelligence, emotion, will, etc.

1. The development of the brain in animals increases in proportion to their intellectual capacities. This is especially noticeable in the number and complexity of the convolutions which enlarge the area of the cortical substance. 2. Congenital smallness or degeneration of the superior hemispheres, as observed in hydrocephalus and in cretinism, is invariably accompanied by a corresponding diminution of the mental powers. 3. Injury and disease of the hemispheres give rise to states of mental excitement, confusion of ideas, stupor or coma, etc.

The Localization of the Functions of the Brain. Eminent neurologists of a past period acknowledged no difference in the functions of limited areas of the cortex. The so-called system of phrenology of Gall is an untenable superstructure founded on unreliable data. It was only when Broca began to offer anatomical evidences of the existence of a "speech center" that a new impetus was given to the inquiry concerning the localization of brain functions, and which led to the remarkable experiments of Fritsch, Hitzig and Ferrier. The methods employed by these observers and the results they obtained were as follows: When limited areas of the brain surface were stimulated by the galvanic current, the animal made certain uniform movements; and conversely, when the same areas were extirpated, such movements could not be evoked for at least a considerable time. Thus the animal would move a foreleg, a hindleg, or the eye whenever the electric stimulus was applied to a particular spot of the cortex. On this principle the cortical surface is mapped out in so-

called psycho-motor centers. Ferrier's figures are constructed on such a plan. In those areas of the human brain which correspond to analogous areas of the monkey brain, he localizes the centers for the special movements which the experiments had elicited and marked them accordingly. From these figures it appears that the principal "motor zone" is located about the superior portions of the ascending frontal and ascending parietal convolutions, *i. e.* those convolutions which are in the immediate neighborhood, or on each side of the upper portion of the fissure of Rolando. It is a significant fact that large pyramidal cells abound in this region of the cortical layer.

The Function of Speech. Circumscribed lesions of the left hemisphere affecting the island of Reil or its adjacent parts,—the third frontal and superior parietal convolutions,—are now so frequently found in connection with defects or loss of speech, that the existence of a "speech center" may be accepted as an established fact in cerebral physiology. Disturbances of speech due to pathological changes of said regions of the brain are classed under the common name aphasia. An aphasic patient may have completely lost the memory of words, or he may be able to repeat them on dictation, or copy them in writing though he does not understand their meaning. He is therefore unable to convey his thoughts in language; the fault being here on the intellectual side,—this is "amnesic aphasia." Another aphasic patient remembers words and their meanings very well, and can make himself understood in writing, but is incapable of giving utterance to his thoughts in articulate language; he cannot co-ordinate the movements involved in speech; the fault being here on the motor side,—this is "ataxic aphasia." A number of other disturbances of speech having the dysphasic character are met with, resulting from disease of the mentioned portions of the brain.

The Functions of the Central Ganglia. The central, or, as they are frequently called, the "basal ganglia," consist of the corpora quadrigemina, the thalami optici, and the corpora striata. These grey masses, in view of their central location and their extensive connections, evidently subserve highly important functions, which are but imperfectly known. It is certain that they constitute nervous mechanisms which, under normal conditions, induce reflex and co-ordinate movements, independent of volitional impulses. Very singular movements of a compulsory nature are witnessed in animals when these nervous masses are injured or destroyed. The animals

PSYCHO-MOTOR CENTERS.

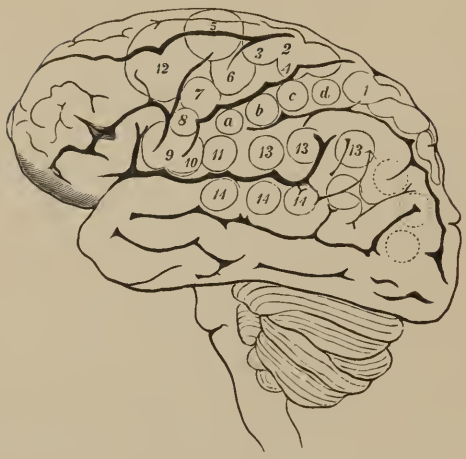

FIG. 3.—SIDE AND UPPER VIEW OF THE BRAIN OF MAN.

(*According to Ferrier.*)

1 On the posterior parietal (posterior parietal lobe). Advance of the opposite hind limb, as in walking.

2, 3, 4 Around the upper extremity of the Fissure of Rolando. Complex movements of the opposite leg and arm and of the trunk, as in swimming.

a, *b*, *c*, *d* On the posterior parietal (posterior central convolution). Individual and combined movements of the fingers and wrist of the opposite hand. Prehensile movements.

5 At the posterior extremity of the superior frontal convolution. Extension forward of the opposite arm and hand.

6 On the upper part of the antero-parietal or ascending frontal convolution (anterior central). Supination and flexion of the opposite forearm.

7 On the median portion of the same convolution. Retraction and elevation of the opposite angle of the mouth by means of the zygomatic muscles.

8 Lower down on the same convolution. Elevation of the ala nasi and upper lip.

9, 10 At the inferior extremity of the same convolution (Broca's). Opening of the mouth with protrusion (9) and (10) retraction of the tongue. *Region of Aphasia.* Bilateral action.

11 Between (10) and (11) and the inferior extremity of the posterio-parietal convolution. Retraction of the opposite angle of the mouth; the head turned slightly to one side.

12 On the posterior portion of the superior and middle frontal convolution. The eyes open widely, the pupils dilate, and the head and eyes are turned toward the opposite side.

13, 13′ On the supra-marginal lobule and angular gyrus. The eyes move towards the opposite side with an upward (13) or downward (13′) deviation. The pupils generally contracted. Center of vision.

14 On the infra-marginal or superior (first) tempero-sphenoidal convolution. Pricking of the opposite ear; the head and eyes turn to the opposite side and the pupils dilate largely. Center of hearing.

show an irresistible tendency to roll around the longitudinal axis of the body, or move continually in a circle either toward or away from the side (circus movements, manege). Certain forms of vertigo appear to be due to a similar defect in the working of the co-ordinating machinery located somewhere in these basal ganglia. In an affection of the semicircular canals of the internal ear (Menier's disease), there exists a tendency in the individual to fall over on one side.

The Corpora Quadrigemina. Destruction of the corpora quadrigemina in animals prevents contraction of the pupils. Irritation of the anterior nates causes dilatation of the pupil on the affected side, and also movement of the eyeballs toward the opposite side. From these movements, and from the fact that the corpora quadrigemina are directly connected with the optic nerve and the nucleus of the motor oculi, it may be concluded that this organ is the center for the movements of the pupils and of the eyeballs.

The Thalami Optici. The inference that this organ is a sensory center rests upon its connection with certain tracts of nerve fibres of the spinal cord that pass upward to the hemispheres. This opinion receives additional support from pathological and clinical observations; but direct evidence from experimental investigations is wanting. Experiments on pigeons appear to indicate that the thalamus is concerned in the function of vision. When injured, it gives rise to forced movements.

The Corpus Striatum. This central mass includes the caudate body and the lenticular nucleus. From its close connection with the peduncles of the brain, and from the fact of its great development in the higher order of animals, it is inferred that the functions of this organ are of an important character. The striated body is probably concerned in the operation of conscious sensations and movements. Injury to the lenticular nucleus is invariably followed by hemiplegia of the opposite side.

The Crus-Cerebri and Pons-Varolii. The functional importance of these parts of the brain is evident from their intermediate position between the higher centers and the spinal cord. Pathological changes in these organs must, therefore, necessarily give rise to very serious symptoms.

The Cerebellum. This organ is a center of co-ordination. Injury to the cerebellum in birds prevents the act of flying. A tottering

gait is one of the most common symptoms in cerebellar disease. The belief that the sexual instinct has its seat in this organ is not supported by sufficient evidence.

The Functions of the Medulla Oblongata. In the disposition of the grey and white substances there is considerable difference between the medulla oblongata and the spinal cord, but less in regard to function. The physiological importance of the medulla exceeds that of any other portion of the cerebro-spinal axis. It contains not only the roots of all the cranial nerves from the sixth downward, but also those automatic and reflex centers which are indispensable to the maintenance of the general system. They may be briefly enumerated as follows:

1. *The Respiratory Center.* Injury to a spot near the calamus scriptorius suddenly stops the act of respiration, causing death in warm-blooded animals.

2. *The Cardio-Inhibitory Center.* This center regulates the action of the heart; certain nerve fibres from the pneumogastric are connected with this organ. Their irritation retards or inhibits cardiac action.

3. *The Vaso-Motor Center.* This consists of a group of large multipolar cells in the upper part of the fourth ventricle, from which a system of nerves arises that enters the spinal cord, and are distributed to the muscular coats of the arteries and capillaries.

4. *The Center for Deglutition.* Spasmodic efforts of deglutition are observed when the medulla is morbidly excited. The precise location of this center has not been determined. Deglutition being a reflex act, it resembles, in this respect, the orderly reflexes of the spinal cord. On similar grounds it is inferred that the innervation of masticatory movements comes from a center in the medulla. Irritation of this center induces the phenomenon of trismus. It must be understood that the central apparatus of these reflex movements is also controlled by voluntary impulses.

5. *Diabetic Center.* Injury of the floor of the fourth ventricle causes a temporary increase of the urinary excretion (diabetes insipidus). Recent investigations render the existence of a glucogenetic center doubtful. It is more probable that diabetes mellitus depends upon lesion of the vaso-motor center which causes paralysis of renal and hepatic vessels.

The fact that vomiting without a palpable cause is frequently wit-

nessed in brain affections has suggested the existence of a center in the medulla controlling the movements of the stomach; but the gastric disturbance can be better explained on the supposition that it is of a reflex character, depending upon excitation of the pneumogastric.

The Arterial Circulation of the Brain. The peculiarities of the arterial circulation in the brain exercise an important influence on the pathology of this organ. Unlike the spinal cord, with its well-defined systems of nerve tracts, the encephalon presents no such clear anatomical divisions; but, owing to the arrangement of its arterial distribution, cerebral lesions are apt to occur in certain vascular districts. This is particularly true of cerebral hemorrhage and softening.

The brain derives its red blood from two sources—the vertebral arteries and the internal carotids. The former unite and form the basilar artery, which gives off the two posterior cerebral arteries. The carotids divide at the base of the brain into two large branches—the anterior cerebral and the middle cerebral arteries. These two sets of arteries unite by anastomosing vessels, and form the circle of Willis. A large number of nutrient vessels, coming from each of their principal branches, penetrate the brain and furnish it with arterial blood. The vascular system belonging to the middle cerebral artery will be considered first. This artery enters the fissure of Sylvius and there divides into several branches. Its cortical branch is distributed to the third frontal convolution, to the two central convolutions and to the parieto-temporal convolution. Its internal branch goes to the greater part of the caudate body of the corpus striatum, to the whole of the lenticular nucleus, to a portion of the thalamus opticus, and to the internal capsule. Branches of the anterior cerebral artery go to the convex and basal side of the first and second frontal convolutions and to the inferior portion of the ascending frontal convolution. The posterior cerebral artery sends branches to portions of the temporal convolutions, to the whole occipital lobe, to a portion of the thalamus opticus, to the peduncles of the brain, and to the corpora quadrigemina. It is important to remember that, although the cortical central systems of the arterial ramification in the brain have a common origin, yet they do not anastomose at any point.

The Sympathetic System of Nerves. Much obscurity prevails concerning the functions of this portion of the nervous system. The

old opinion that the ganglionic system of nerves is exclusively engaged in the innervation of the vegetative organs is now abandoned. It is certain that they transmit impulses to the nerve centers precisely in the manner of the cerebro-spinal nerves. Many physiological and pathological theories take it for granted that the ganglions constitute independent centers of nerve action.

The Vaso-Motor System of Nerves. Claude Bernard's brilliant experiment demonstrated the existence of a class of nerves (probably a part of the great sympathetic) which are distributed to the contractile tissue of arteries, veins and capillaries. They subserve the following important functions: 1. The "tone" of the arterial circulation depends upon the constant action of these nerves. 2. They regulate the blood pressure in accordance with the wants of the general system. 3. By means of a reflex mechanism, they act indirectly on circumscribed vascular districts. 4. Direct excitation of the vaso-motor center, as in blushing, causes localized vascular dilatation. 5. Vaso-motor disturbances produce local changes of temperature, resulting either from an increased or diminished amount of blood in the vessels in proportion to the dilatation or constriction of their calibre.

Strong evidence has been brought forward to prove the existence of distinct vaso-constrictor, vaso-dilator, and secretory nerves.

Trophic Nerves. A great number of clinical observations suggest the existence of a particular set of nerves that influence the nutrition of tissues. Magendie divided the trunk of the trifacial nerve and witnessed, in consequence, the destruction of the eyeball. Section of motor nerves causes degeneration and wasting of the muscular fibre. The observations of Weir Mitchell are exceedingly interesting. This author describes a variety of "trophic" changes resulting from injuries to peripheral nerves. Among them he mentions a peculiar condition of the skin, especially marked in the fingers and toes, which presents a glossy appearance. The cutaneous eruption in herpes zoster is probably due to "trophic" disturbances. Austie observed a white patch of hair over the course of the affected nerve in neuralgia of the scalp. Still the existence of a distinct class of "trophic" nerves is problematical, for the role assigned to them may be properly ascribed to the action of vaso-motor nerves.

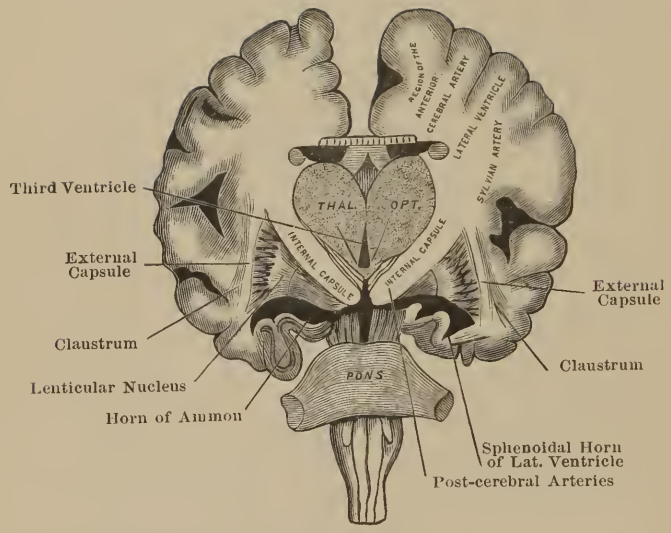

FIG. 4.—VERTICO-TRANSVERSE SECTION OF THE BRAIN, POSTERIOR TO THE TUBERCULA MAMMILLARIA, ANTERIOR TO THE PEDUNCLE.—(*Charcot.*)

The System of Communicating Nerve Fibres in the Brain.

The white or medullary substance of the brain consists almost exclusively of nerve fibres. They may be thus divided:

1. Associating fibres, which connect different portions of the cortical substance. 2. Commissural fibres, which unite symmetrical parts of the brain (corpus callosum, anterior commissure). 3. Radiating fibres, which keep up communication between the cortex, the basal ganglia and the spinal cord. Meynert classifies all the sensitive and motor fibres on the principle of their projection in the brain. He adopts three "orders" of such a projection system. The first order connects the cortex with the large central ganglia (corona radiata); the second connects these ganglia with the grey substance of the medulla oblongata and of the spinal cord (peduncles), and the third composes the peripheral expansion of fibres.

For the purpose of gaining a clearer conception of the reciprocal relations of the grey masses of the brain and the communicating nerve fibres, it is best to make a number of vertico-transverse sections of the brain at different levels. The annexed diagram, from Charcot, presents such a section at the level of the corpora quadrigemina.

At the inferior and median part of the section two large white tracts of nerve fibres, called the internal capsules, are observed, which diverge toward the cortical substance of the hemispheres. These tracts are the prolongations of the cerebral peduncles. Their fan-shaped expansion to all the lobes of the brain is named the corona radiata. The internal capsule separates two central masses of grey matter; the one superior and internal, the other inferior and external. The grey mass which is above and inside of the capsule, is the thalamus opticus. The smaller mass is the head of the caudate body of the corpus striatum; the one on the outside and below the internal capsule is the lenticular nucleus with its three segments. The external capsule, which is also composed of a bundle of nerve fibres, is on the outside of the latter; and next to this, a grey lamina, the claustrum, which faces the island of Reil.

Nature of Nerve Action. The intrinsic change that takes place in a nerve when in a state of excitation is only a matter of speculation. Two hypotheses may be conceived in explanation of nerve action. The one refers the phenomenon of the transmission of sensory and motor impulses to molecular action. It assumes that the nerve

molecule to which the stimulus is applied, imparts its movement to its next neighbor, and so on throughout the whole series of molecules, resembling the communication of movement in a row of balls. The other hypothesis ascribes the nervous impulse to a chemical change, which liberates force stored up in the nervous tissue, like the discharge from the firing of a train of gunpowder by a spark.

CHAPTER II.

GENERAL SYMPTOMATOLOGY OF NERVOUS DISEASES.

Sensory Disturbances.

Hyperæsthesia signifies augmented sensibility. In this abnormal condition of the nervous apparatus, ordinary stimuli produce painful sensations and evoke a heightened reflex excitability. Some source of irritation must therefore be assumed to dispose a sensory nerve, a nerve-root, or more especially the spinal cord, to react with exaggerated intensity. Hyperæsthesia is a prominent symptom in spinal meningitis, hydrophobia, tetanus, strychnia-poisoning, and hysteria.

New terms have lately been introduced to distinguish with greater precision the different varieties of disturbed sensation. *Hyperalgia* denotes exaltation of common sensations; *Analgia*, the opposite condition; *Hyperalgesia* refers to pain and the important class of neuralgic affections; *Analgesia* designates that abnormal state of sensibility in which no pain can be elicited in certain regions of the skin.

Pain. Although pain is emphatically a subjective symptom, and therefore, as a general rule, unreliable for diagnostic purposes, yet it not unfrequently constitutes the only evidence of disease. In illustration of this fact, it is only necessary to allude to the knee pain of hip-joint disease; the double sciatica of loco-motor ataxy; the violent paroxysmal pains of internal aneurisms, etc. An accurate knowledge of nerve-intercommunications often clears up an obscure affection which gives no other intimation of its existence than pain in distant parts of the body. This subject will again come under consideration in connection with neuralgia.

Anæsthesia. Diminution and complete loss of cutaneous sensibility constitute the principal, but not the only forms of anæsthesia. Anæsthesia is also recognizable by retarded transmission of sensory

impressions. The different qualities of sensibility may be collectively or only partly abolished. Tactile sensation is conveniently tested by touching the skin with a blunt instrument; pain, by the pricking of a needle; thermic sensibility, by the application of a warm or cold substance; the capability of localizing sensations, by touching certain regions of the skin whilst the patient has his eyes closed; and spatial differences between points of contact, by varying the distance between the points of a compass. The muscular sense is judged by the appreciation of weights. When greater accuracy is desirable, it is best to make use of the instruments devised for such experiments, as the æsthesiometer, dynamometer, etc.

Incomplete Anæsthesia is commonly recognized by the feelings of numbness and furriness. Patients sometimes experience a sensation at the finger ends as though they were covered with silk; or they have a sensation at the soles of the feet as if standing or walking on an elastic substance.

Paræsthesia. Certain undefinable sensations of a distressing character are designated by this term. What is called "præcordial anxiety" resembles a feeling of compression or constriction in the region of the heart. It occurs in nervousness and hysteria, but with greatest severity in angina pectoris. Various other subjective symptoms are usually grouped among these morbid sensations, such as formication, tingling, pricking, a feeling as if the part were asleep, flushes of heat or chilliness in different parts of the body, due, probably, to local vaso-motor disturbances.

Local Anæsthesia. Anæsthesia of peripheral origin is witnessed in traumatic lesions of nerve-trunks, in neuritis and pressure of tumors. The circumscribed anæsthesia from the application of cold, or rather the abstraction of heat, is utilized by the surgeon by means of the ether spray. Numbness of the finger ends is a common complaint among washerwomen. Persons who follow occupations that require the constant handling of fine metallic substances, or who expose their fingers to the action of acid fluids, often suffer from a similar form of local anæsthesia.

Spinal Anæsthesia. Lesions of the grey substance and of the posterior columns of the spinal cord interrupt the transmission of sensory impressions from the periphery to the perceptive centers, and must necessarily give rise to cutaneous anæsthesia. Traumatic

injuries to the cord are nearly always followed by loss of sensibility, for usually the whole thickness of this organ becomes involved, and hence sensory and motor paralysis in the form of paraplegia is the rule in this class of cases. Bilateral or symmetrical anæsthesia, mostly of the lower extremities, is, with rare exceptions, characteristic of spinal disease. The extent and completeness of spinal anæsthesia vary with the spread and intensity of the lesion. Progressive anæsthesia in spinal affections is due to ascending secondary degeneration.

Cerebral Anæsthesia. As the localization of sensory centers in the brain is far from being satisfactorily determined, we must look for information to the morbid anatomy in those diseases of the encephalon which are accompanied by loss of cutaneous sensibility. Anæsthesia has been observed in lesions of the medulla oblongata, the pons varolii, the crura cerebri, the basal ganglia and the cortical substance. But in the vast majority of cases the anatomical changes will be found in one of the following parts of the brain: the superior portion of the thalamus opticus, the third segment of the lenticular nucleus and the inferior third of the internal capsule. Incomplete and circumscribed loss of cutaneous sensibility is, in general, characteristic of anæsthesia from brain lesion. In abscess and tumors of the brain, the symptoms of irritation and excitement predominate. Anæsthesia can be frequently discovered in chorea, epilepsy, and the cataleptic state. Hemianæsthesia is common in hysteria.

Motor Disturbances.

The subjects for consideration under this head include the important groups of paralytic and convulsive affections.

Paralysis (Akinesia). Paralysis means a state of more or less immobility of muscular organs dependent on a want of motor innervation. Loss of muscular power from any other cause is not, strictly speaking, paralysis. In every case of paralysis some pathological change must have taken place in the nervous system which either interferes with the volition or the conduction of motor impulses. If this morbid alteration involves the center of volition, although the rest of the nervo-muscular apparatus be intact, no voluntary movement can occur; and, similarly, if the volitional center be free, but the paths which connect it with muscular organs are interrupted,

paralysis must necessarily ensue. The general muscular relaxation in states of unconsciousness, and the immobility observed in hysterical patients due to abeyance of the will, are examples of true central paralysis. Practically, however, it is the paralysis resulting from anatomical alterations of the brain and of the spinal cord that is mainly to be considered.

Cerebral Paralysis. Hemiplegia is the typical form of paralysis in brain disease. It is a cross paralysis, for the loss of voluntary motion is on the side of the body opposite to that of the lesion. The loss of muscular power may be complete or incomplete (paresis), or the several parts may be affected in different grades of intensity. Hemiplegia usually affects one side of the face and the upper and lower extremities of the same side. Alternate paralysis occurs in lesions of the pons and peduncles—monoplegia in diseases of the cortex. General paralysis, in which both sides of the body are simultaneously affected, is but rarely witnessed, as it rapidly leads to a fatal termination. Cases of cerebral paralysis may present all the clinical features of the peripheral variety. This will happen if, for example, the motor oculi be caught by a lesion at the base of the brain, which is not an uncommon occurrence in intracranial syphilis.

Head Symptoms. The general symptoms common to many diseases of the brain and the meninges are usually spoken of as "head symptoms." Their diagnostic importance mainly depends upon the presence of more significant signs of cerebral trouble. Functional disturbances of the brain, it must be remembered, are exceedingly common in all acute febrile conditions, and in many affections of remote organs. They come and go with the primary disorder and usually attract but little attention. The chief cephalic symptoms comprise headache, vertigo, delirium, insomnia, somnolence, stupor, coma, and general convulsions.

Among the adventitious symptoms may be enumerated nausea, vomiting, constipation of the bowels, and disturbances of sight and hearing.

Headache. Violent and persistent pain in the head is a constant symptom in acute meningitis, cerebral abscess and intracranial tumors. The pain may be limited to a certain spot or shift from one place to another, or be diffused over the whole head. Sometimes patients complain only of fullness, weight, or constriction of the head. Uræmic convulsions are often ushered in by intense headache. Children

manifest severe pain in the head by a peculiar abrupt, piercing cry, and by boring the head into the pillow. The pathology of headache is very obscure. Physiology teaches that the brain substance is insensible to pain. The dura-mater, however, becomes highly sensitive when morbidly affected. This membrane receives filaments from the trigeminus.

Vertigo. This symptom frequently accompanies headache. In most cases it merely amounts to a slight feeling of dizziness. Well marked vertigo is common in cerebral anæmia. It is occasionally due to an affection of the ocular muscles, and is a prominent symptom in Menier's disease.

Delirium. The mental disturbance designated by this term embraces aberration of the senses and delusions. Delirium may assume all conceivable grades of intensity, from mere confusion of mind or wandering, to a state of maniacal excitement. It is recognized by incoherence of language, false and fanciful ideas, and disorderly or violent conduct. Although delirium presents all the clinical features of insanity, it is distinguished from the latter by the fact that it is only a symptom and not a substantive mental disease. Like headache, it makes its appearance under the influence of various and opposite pathological conditions, and for this reason it is ordinarily a symptom of little diagnostic value. In certain nervous affections, however, the peculiarity of the hallucinations or delusions is of some significance. Thus the hallucinations of delirium tremens are usually repulsive to the patient and inspire his fear. The delusions of the demented paralytic partake of exaltation and grandeur.

Insomnia. Somnolence. Coma. The function of sleep is variously disturbed during the course of many cerebral affections. An excited condition of the brain is incompatible with quiet and rest. Patients complain of wakefulness; and the short snatches of sleep are disturbed by unpleasant dreams. Prolonged insomnia is a very grave symptom. Drowsiness is frequently a premonitory sign of brain trouble in children. Grinding of the teeth, champing of the lips, and sudden starts during sleep, often announce an attack of infantile convulsions. Somnolence is not unfrequently the precursor of the more serious symptoms of uræmic poisoning. The usual mode of death in fatal brain diseases is by coma. It indicates paralysis of the nerve centers, mostly from compression, and may alternate with or immediately follow general convulsions.

Nausea; Vomiting. These gastric disturbances are sometimes of such great prominence as to mask the nature of the original disease. Vomiting without any obvious cause, in children of tender age, should always arouse suspicion of serious brain trouble. Adults suffering from brain tumors are occasionally afflicted with gastric derangements of such great severity, especially nausea and vomiting, that the primary cause may remain unsuspected for a long time.

Cerebral Breathing. By this is understood an irregular panting or noisy respiration. It is usually associated with a jerky, rapid pulse. This symptom forebodes danger, as it points to the implication of important nerve centers. The so-called "Cheyne-Stokes" respiration is an aggravated form of cerebral breathing. It is marked by an alternating series of exceedingly rapid and slow respiratory movements.

The Tache Cerebral is a test of the cutaneous circulation. On passing the finger quickly over a part of the skin (for which purpose one of the inguinal regions is usually selected), a red streak will appear upon its removal. This redness is comparatively slow in disappearing when the circulation is depressed, as it often happens in cases of acute brain disease.

Eye Symptoms. Abnormal sensitiveness to light (photophobia) occurs in hyperæmia and inflammation of the brain and its membranes. Flashes of light, iridic colors and spectra, dimness of sight (amblyopia), double vision (diplopia), total blindness (amaurosis), and other disturbances of the organ of vision, are not uncommon in cerebral affections; but these ocular symptoms must not be confounded with analogous conditions of the eye dependent on local causes.

Pupillary Changes. The clinical significance of pupillary changes can only be adequately appreciated if the reflex mechanism regulating the movements of the iris be properly understood. The size of the pupil under normal conditions is determined by the quantity of light that enters the eye. So long as there exists but the feeblest sensibility to light, the pupillary reaction will take place, whether the light acts upon one or both of the retina. It must be remembered that the stimulus of light exciting the retina is propagated by both optic tracts (on account of the semi-decussation at the chiasm), first to the corpora quadrigemina and then to the nucleus of the motor

oculi nerve. Some of the branches of this nerve transmit the impulse to both irides, which contract to an equal degree.

Inequality of the pupils occurs: 1. When any one of the integral parts of this reflex mechanism becomes disturbed in its function. Let us suppose that on illuminating the right eye, its pupil fails to contract, but that the pupil of the left eye does; it is certain that the optic nerve of the right eye is sound, for otherwise the pupil of the left eye would not contract. The want of contraction in the right eye must either depend upon some local cause that interferes with the movements of the iris, or the corresponding branch of the right motor oculi is paralyzed. If both pupils react to light in cases of total blindness, as in uræmic amaurosis, it must be concluded that the blindness is caused by an interruption in the course of the nerve fibres that convey the visual sensation to the higher centers. 2. Pupillary changes are known to be also influenced by the act of accommodation, or, rather, the grade of convergence. The pupils contract when they look at near, and dilate when they look at distant, objects. The pupil is dilated and immovable from paralysis of the peripheral branches of the motor oculi. This is frequently observed in brain lesions that involve the nucleus of this nerve. Unilateral dilatation and immobility of the pupil is characteristic of syphilis. 3. A third source of abnormal action of the pupils must be sought for in morbid conditions of the sympathetic. Experiments show that irritation of the cervical sympathetic causes dilatation; its division, contraction of the pupils. The fibres which act as afferent nerves can be traced to the medulla oblongata and to the cervical region of the spinal cord, from whence they emerge and connect with the sympathetic that sends afferent fibres to the iris. Dilated pupils occurring in hemicrania, nephritic colic, and in children troubled with worms, are examples of irritation of the sympathetic. 4. Dilatation of the pupils is a constant symptom of chronic hydrocephalus and epilepsy, and is frequently observed in brain tumors. The best test of mydriasis depending either upon irritation or paralysis of the sympathetic, is the application to the eye of a weak solution of atropia. In the former case the pupils greatly enlarge, while in the latter they hardly show any increase of dilatation.

Spinal Paralysis and Associated Symptoms. Bilateral paralysis, or paraplegia, is typical of injury and organic disease of the spinal cord. The term paraplegia is usually applied to paralysis of both lower

extremities; but it must be understood that in lesions of the cervical region of the cord, the upper extremities are also affected. According to the experiments of Brown-Sequard, section of one-half of the spinal cord produces motor paralysis, and heightened sensibility on the side of the injury and anæsthesia on the opposite or uninjured side. The extent of spinal paralysis varies with the height at which the lesion is situated, and is proportionate in intensity to the amount of tissue involved.

The sphincters are liable to be seriously affected in every form of spinal paralysis, and the virile powers are weakened or finally abolished. Ischuria or incontinence of urine in the course of chronic paraplegia, constitutes an ominous symptom, as it leads to the development of cystitis. Elevation of temperature is occasionally observed in recent cases of spinal paralysis; but subsequently it falls below the normal range. This symptom is referable to disturbance of the vasomotor nerves which are known to pass out of the vertebral canal in company with the anterior nerve-roots. Reflex excitability may be either increased or diminished. It is increased when the injury is situated below the reflex arc, and diminished when situated above. Reflexes cannot be excited when the sensitive fibres are disconnected from their corresponding motor centers. Atrophy of the paralyzed muscles is not common in ordinary myelitis; and if it occurs, usually in connection with deterioration of the electric reaction, it must be attributed to progressive degeneration of the spinal cord.

Peripheral Paralysis. The principal causes of peripheral paralysis in the order of frequency, are injuries to nerves, acute and chronic neuritis, rheumatic, toxic and infectious influences, syphilis and ischæmia. The changes in injuries of the nerves have been well studied in animals. After section of a nerve-trunk, all the muscles to which its fibres are distributed become paralyzed. The nerve below the seat of injury undergoes a process of degeneration, and the muscles waste. Regeneration of the divided nerve may take place when the cut ends are not too far apart. Compression of nerve-trunks and roots resulting from tumors, diseased bones and abscesses, produce a similar change in the nerve fibre. The paralysis due to rheumatic influences and the diphtheric poison presents all the peripheral characteristics. Among them none is of more significance than the abnormal electric reaction of the paralyzed nerves and muscles, which corresponds with the more or less degenerative

changes they have undergone. It is singular that the paralyzed muscles may regain their power to respond to voluntary impulses although electric stimulation is still incapable of exciting contractions. Besides these peculiarities of electric reaction, it is of diagnostic importance to remember that peripheral paralysis seldom assumes the hemiplegic or paraplegic type. It may happen that in injury or disease of the cauda equina, the paralysis will present the paraplegic character; but the extent of the paralysis, owing to the limited nerve distribution, is much less than in spinal disease. Vasomotor changes and muscular atrophy are the usual concomitants of peripheral paralysis.

Hyperkenesia. Motor disturbances of an irritative nature are characterized by excessive or irregular movements. The special forms comprise convulsions, cramps, choreic movements, athetosis, tremor and contractures.

Convulsions. A paroxysm of convulsions or spasms consists of a succession of involuntary muscular contractions. Spasms are said to be clonic when the alternate contraction and relaxation of muscles produce jerky movements. Tonic spasms are distinguished by a greater rapidity in the recurrence of the contractions, so that the muscular fibres appear to be in a constant state of rigidity. The latter variety of spasms is relatively of a more dangerous character, as the exciting cause is more persistent. This is well exemplified in tetanus.

Cramps are painful contractions. The gastrocnemii, and among the involuntary muscles, those of the intestines, are particularly liable to be thus affected.

Choreic Movements are marked by an irregular impulsive action of groups of muscles. Volition has only a partial command over the movements, which constantly tend to diverge from the intended direction.

Involuntary Rhythmical movements, as first described by Hammond under the name of athetosis, are occasionally observed in organic affections of the central nervous system.

Tremor essentially consists of contractions and relaxations affecting small bundles of muscular fibres, which occur with such great

rapidity that one set of fibres begins to contract while another set is still relaxed. This morbid phenomenon is exhibited in animals whose voluntary control over a muscle has been destroyed by division of its motor nerve. Tremor in the human subject appears to be due to an analogous cause. It is frequently observed in elderly persons and inebriates, in wasting palsy and in atrophy of muscles from lead poisoning. Tremor is the leading symptom in paralysis agitans, and multiple sclerosis of the brain and spinal cord.

Contracture means a permanent shortening of muscles. Paralyzed limbs are liable to be affected in this manner, and tend to become distorted in consequence.

CHAPTER III.

MEDICAL ELECTRICITY.

The electric currents in use at present for medical purposes are:

1. The Galvanic or Constant Current.
2. The Faradic or Interrupted Current.
3. Static Electricity.

Electro-Physics. As a preliminary I shall refer to a few elementary facts in electro-physics. The source of galvanic electricity consists of the contact of heterogeneous metals which are submitted to chemical action. The simplest arrangement for generating this form of electricity is a combination of a zinc and copper plate, which are dipped into a glass vessel filled with dilute sulphuric acid. To each of the plates outside of the fluid a copper wire is attached, and, as soon as these wires are joined, the electricity which accumulated at the extremity of each plate begins to circulate in the connecting wires. The current of electricity thus established continues until the metal plates are completely oxidized. Such a contrivance is named an element or cell. The combination of a number of such elements, arranged in a series of alternate plates of copper and zinc, or carbon and zinc, constitutes a battery.

It is understood that the plates at each end of a series are always composed of dissimilar metals.

The direction of the current inside of the cell is from the zinc to the copper, hence outside of the cell the electricity flows from the wire connected with the copper to the wire attached to the zinc. It has been agreed to name the terminal of the wire connected with the copper the positive pole or anode, and that connected with the zinc the negative pole or kathode. If the human body be interposed between the extremities of the poles, then the current enters at the positive and passes out at the negative pole.

Electro-Motive Force. The work which a quantity of electricity can perform is named its electro-motive force. This working capacity

of a current is influenced in a definite manner by the resistance it meets in its passage. There are two sources of such a resistance—the resistance in the battery itself (the fluid, connecting wires), named the "specific resistance," and the resistance offered by the interposition of any outside substance, say the human body, named the "external resistance." These conditions regulate the strength of a current. Thus, if we represent the current strength by C, its electro-motive force by E, and the specific resistance by R, then we have $C=\frac{R}{E}$. If we make E equal to 5 and R equal to 100, then $C=\frac{5}{100}=\frac{1}{20}$. It is apparent that we cannot increase the strength of a current by multiplying the number of elements, since for each increase of the electro-motive force we get a proportional increase of resistance. For instance, if we use 2 elements we have $C=\frac{5}{100}\times 2=\frac{1}{20}$, and obviously with a like result for any greater number of elements. It is different when the external resistance is very great in comparison to the specific resistance. This occurs in practice when the human body or any of its parts is interposed. Giving the same value as above to E and R, let us call R' the external resistance and say it is equal to 1000, we then have the equation

$$C=\frac{\frac{E}{5}}{R100+R'1000}=\frac{5}{1100}=\frac{1}{220}.$$

If we now use two elements, then $C=\frac{2\times 5}{R100+R'1000}=\frac{1}{120}$. The strength of the current is thus nearly doubled, for the external resistance is the same for any greater number of elements than one. From this it follows that the strength of a current is in direct proportion to its electro-motive force and in inverse proportion to its resistance. This is "Ohm's Law," which may be thus formulated: "The strength of a current is proportionate to its electro-motive force divided by the resistance."

Electric Units. Practical electricians have introduced certain technical terms which express with great precision the strength of a current. It would answer no useful purpose to enumerate them, and it is not within the scope of this work to enter into a detailed account of this subject.

Fig. 5.

This diagram is intended to illustrate the diffusion of the current throughout the arm, irrespective of the points of application of the electrodes. It also illustrates the greatest density of the current in the immediate vicinity of both electrodes of equal size, which are placed over a nerve (ulnar). The inactive rays of the current are marked by dotted lines; the shaded parts indicate the regions of greatest density.

Density of a Current. In order to form a clear conception of the density of a current, let it be supposed that an electric current consists of a bundle of parallel rays. It is obvious that the strength of the current will vary with the number of rays, and that it will be the greatest in any transverse section of such a collection of rays. Now each of the terminals of a current contains all the rays where it is applied to a part of the human body, and necessarily exerts there its greatest force. This condition of the strength of a current in relation to a transverse section of its conductor is named its density. It is apparent that the density must be the greatest in the straight line between the two electrodes which transmit the current into the body, it being the shortest route of the current where it meets the least resistance. All the other rays from pole to pole must lose in density in proportion to the length of their circuitous course. Fig. V.

The Conducting Power of Organic Tissues. The inequality of the conducting power among the component parts of the human body also influences the distribution of the current, the resistance it meets being greater or less in the different tissues through which it passes. Muscles and nerves are the best conductors of electricity among all animal tissues. The greatest resistance is offered by the epidermis, though it varies to a great extent in different individuals, and in different parts of the cutaneous surface in the same individual. The following table, according to the investigations of Prof. Erb, shows the practical importance of paying attention to this subject:

Temples,	40°
Cheeks,	50
Sides of Neck,	35
Shoulder Blades,	20
Anterior Surface of Thighs,	3
Popliteal Space,	26
Anterior Surface of Upper Arms,	25
Outer Surface of Upper Arms,	22
Palms of Hands,	20

Rheophores; Electrodes. The conducting cords, or rheophores, as they are called, are attached to the battery and the handles of electrodes by pins or screws. They should be kept in good order and their contact well secured to prevent failure of electrisation. Much stress is laid, by experienced observers, on the choice of the proper

material for covering the disks of electrodes. Flannel or wash leather enclosing a layer of fine sponge is now preferred. Brass sponge holders are objectionable, they are advantageously replaced by wooden cups or carbon plates. Small electrodes serve best for exploration of motor points, and application of the current to trunks of nerves and small muscles. The medium size is adapted for large muscles. The large electrode is used for application to the spine and general electrisation. Electrodes of various shapes and designs to answer particular purposes are supplied by manufacturers.

Batteries.

Among portable galvanic batteries which are offered for sale, there is only a choice of evils. In respect to the constancy of the current, which is a matter of prime importance, they are all good enough for practical purposes, but on the score of portability they fail to fulfil the necessary requisites. The Kidder and the Fleming batteries are improvements of Stohrer's apparatus. A medical Leclanche, although more expensive, is generally preferred.

Faradic Current. Faraday's discovery that a galvanic current, like magnetism, induces new currents in neighboring conductors, has been utilized in the construction of an apparatus which renders such currents of induction available for medical purposes. All the batteries in use which generate the faradic current are modifications of the sledge apparatus devised by Du Bois Raymond. The ordinary faradic battery consists of a short coil of thick wire wound around a wooden cylinder, and connected by one extremity with one of the poles of a galvanic cell, and by the other with the automatic interrupter. The current which generates in the cell, and is interrupted by the alternate opening and closing of the circuit, develops the induction current in the coil. Within the center of this coil are rods of soft iron, which, on becoming magnetized, intensify the current in the spiral. A secondary coil consisting of thin and longer wire, and unconnected with the rest of the apparatus, slides over the primary coil. The rheophores are attached to the extremities of this coil. This current takes an opposite direction to the primary when the circuit is closed through the action of the hammer, and the same direction when it is opened. There is no specific difference in the action of the two currents, but the effect of the secondary spiral increases the more it is slided over the primary. The strength of

either current can be lowered when the iron cores are drawn out. The arrangement for increasing or diminishing the strength of the current differs in different apparatus.

The faradic current, in comparison with the galvanic, possesses inferior chemical or electrolytic power, but it surpasses in the energy of its physiological effects. This is due to the abrupt development and brief duration of the induction currents. The negative pole of a faradic battery can be distinguished from the positive pole by its more vigorous action on the motor and sensory nerves.

Electro-Physiology.

Electrotonus. When a galvanic current passes continuously through a motor nerve no visible effect is produced, but a contraction of the corresponding muscle immediately occurs as soon as the circuit is opened. A contraction again occurs at the moment when the circuit is closed. By alternately lifting and replacing one of the electrodes, or by using the interrupter which is attached to every galvanic battery, such a closing and opening of the circuit is effected. Although the nervous impulse, excited by a continuous current, is only recognizable when there is a make or break of the circuit, nevertheless a change takes place in the condition of the nerve. This consists in an altered state of excitability of the nerve, and such a nerve is then said to be in a condition of *electrotonus.* This modification of excitability is demonstrated by experiment. It has been further ascertained that the excitability is heightened at the point where the kathode lies over the nerve (katelectrotonus), and lowered at the point of contact with the anode (anelectrotonus). It appears, therefore, that the physiological effects of the two poles differ in relation to the condition of excitability which they produce. But they also differ in the circumstances attending the contractions. The admirable experimentation of Pflueger on a dissected nerve resulted in the establishment of the normal formula of contractions. He found that both the apparition and energy of the contractions are influenced by the polarization as well as the duration of the current. In the human subject, however, where different conditions prevail, a different formula of normal contractions obtains, but which is of general application in practice. The experiments that illustrate these "laws of contractions" may be briefly described as follows: A current of minimal strength is used at first, and the anode, to which a large

electrode is attached, is placed on a distant part of the body, and the smaller electrode of the kathode is brought in contact with the surface immediately over the nerve (ulnar or peroneal). If the current be of sufficient strength, a contraction ensues, *i. e.* there will be a kathodic closing contraction; any other polarized current will fail to produce a contraction. The strength of the current must now be sufficiently increased to elicit an anodic closing or an anodic opening contraction. A yet stronger current is requisite to produce a kathodic opening contraction. A healthy nerve will, therefore, respond by a contraction in the following order, according to the strength of the current:

1. Weak current, ... *KCC.*
2. Medium, ... *ACC, AOC.*
3. Strong, ... *KOC.*

Explanation of letters and symbols:

K = Kathode.
A = Anode.
C = Contraction.
C = Closing or making.
O = Opening or breaking.
/ // /// = Signs of intensification.
< > = Crescendo, diminuendo.

The laws of electric contraction in muscles differ in no essential particulars from those of the motor nerves. The response of a muscle to the action of the current is named "the electro-muscular contractility," the sensation experienced during electric contraction is named "the electro-cutaneous sensibility." No effect is produced when the current is thrown transversely through a muscle.

Physiological Effects of the Current in Different Organs.

A sensory nerve responds by a peculiar sensation, which changes into pain when the intensity of the current is increased. The effect is the same whether the nerve be stimulated in any part of its course, or at its peripheral termination. Galvanization causes a stinging or burning sensation; faradization a feeling of tingling with every shock. The faradic current barely affects the special senses, but they promptly respond to the galvanic current. On applying the electrodes of a weak galvanic current to the temples or cheeks, the sensation of a

flash of light is produced. Of much greater theoretical interest are the effects of the current when directed to the auditory nerve. According to the law of normal reactions of this nerve, as formulated by Brenner, auditory sensations of the nature of ringing, hissing or whistling are experienced, when a kathodic make-current or an anodic break-current is applied to the ear. It is certainly remarkable that all the phases of polar excitation characteristic of a motor nerve are reproduced on galvanizing the acoustic nerve.

Galvanization of the tongue causes a peculiar metallic taste, which is also experienced when the electrodes are applied to the cheeks and nape of the neck.

Electric stimulation does not appear to influence the sense of smell.

Galvanization of the Sympathetic. The possibility of so localizing a current that it may act directly on the cervical sympathetic and its ganglia, is doubted by many eminent observers. It is recommended to apply the anode to the part intervening between the mastoid process and the ascending ramus of the inferior maxillary bone, and the kathode to the sixth or seventh cervical vertebra, or to the sternum. In view of the uncertainty overhanging the entire subject of "galvanization of the sympathetic," the following statement regarding its effects can only be provisionally accepted:

1. The arterial blood pressure is diminished as indicated by the slowing of the pulse.

2. The bodily temperature is occasionally increased and sometimes attended by sweating.

The Brain. Electric stimulation of the brain was formerly thought to give rise to no particular phenomena, until Hitzig and Ferrier demonstrated that certain areas of the cortex responded in the manner described in a previous chapter.

Galvanization of the head excites some of the special senses and causes drowsiness and vertigo. Strong currents produce faintness, convulsions, and sometimes nausea and vomiting. Dizziness invariably follows when the current is thrown into the head in a transverse direction.

The Spinal Cord. Therapeutical observations leave no room for doubt that the spinal cord is accessible to the action of the electric current. Large sponges should be selected and applied to the spinal column at a considerable distance apart.

Internal Organs. Only those internal organs which contain muscular tissue respond to electric excitation. Striped muscles react more strongly than unstriped.

Electro-Diagnosis.

Electrical investigations greatly assist the recognition of many diseases of the nervous system. Much experience and familiarity with the sources of fallacy, as in analogous methods of physical diagnosis, are requisite to derive advantage from the results of the exploration. We have seen that healthy motor nerves and muscles react in accordance with the formula of the laws of contractions. Certain deviations from this normal order of contractions are found to correspond with nutritive alterations in the neuro-muscular apparatus. These irregularities consist of quantitative and qualitative changes. The quantitative changes comprise: 1. A difference in the amplitude of the contraction, *i. e.* the contractions manifest either an exaltation or diminution of energy—the electric stimulus may elicit a well-defined, vigorous jerk, or a sluggish, long-drawn wave of contraction. 2. The qualitative change is manifested by an abnormal formula of contractions. Thus, in place of *KCC*, which should be the only polarized contraction according to the normal formula, there may also appear *ACC* and *AOC*, or the *AOC* is equal to *KCC* (*AOC* = *KCC*). It may even happen that *KOC* appears early. Another phenomenon indicating an abnormal reaction is this, that a motor nerve responds to a galvano make and break-current, whilst the farado-contractility is not elicited. At the same time, the normal chronology of polar contractions is altered.

Now, whenever a part of the nervo-muscular apparatus shows any of these abnormal reactions, it may be safely concluded that its tissue has undergone some nutritive or histological change. This abnormal reaction is named the "reaction of degeneration" (*RD*). The pathological conditions of the nervous system which give rise to *RD* include morbid alterations of the grey matter of the anterior horns of the spinal cord, and the channels of trophic influences which proceed from these centers, namely, motor nerves.

The special diseases in which *RD* has been uniformly observed are infantile spinal paralysis, progressive muscular atrophy, lead poisoning, and severe forms of rheumatic paralysis.

It must be borne in mind that wasted muscles, due to a local or

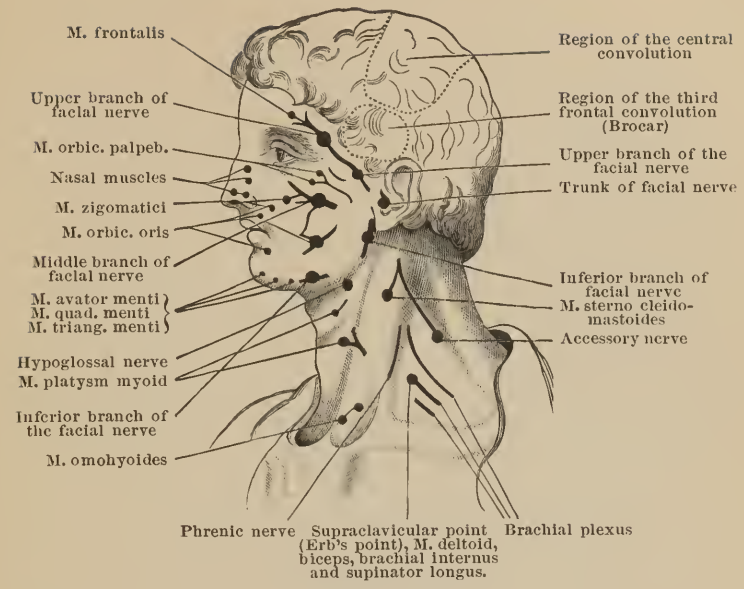

FIG. 6 (*Erb*).

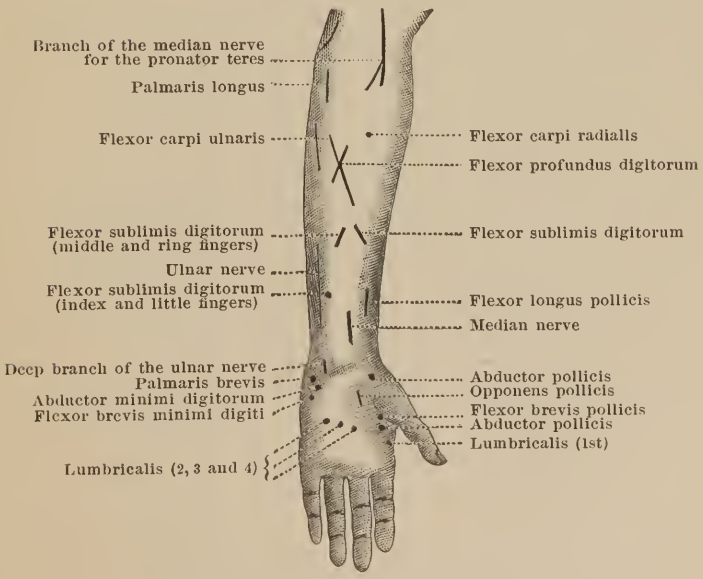

FIG. 7.— ZIEMSSEN'S MOTOR POINTS.

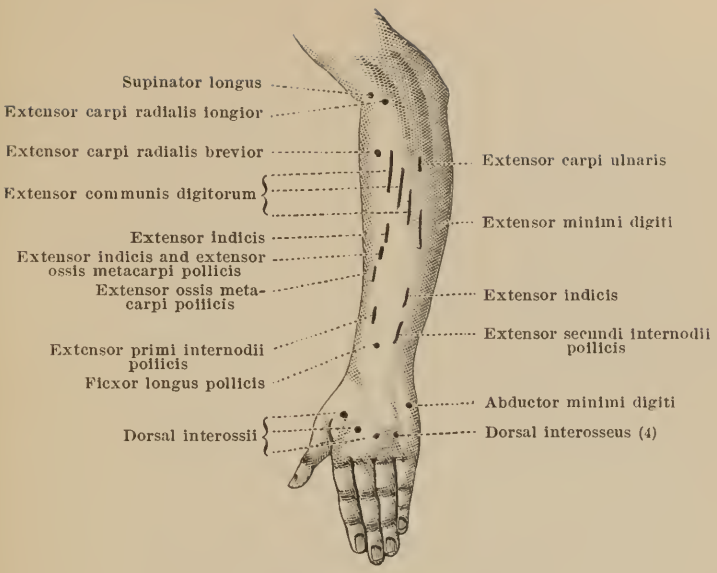

FIG. 8.—ZIEMSSEN'S MOTOR POINTS.

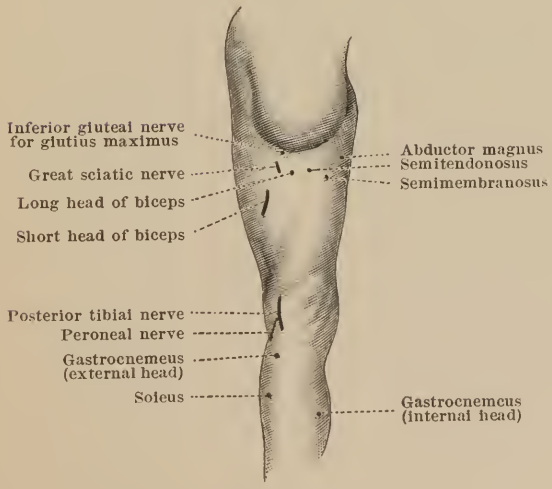

FIG. 9.—ZIEMSSEN'S MOTOR POINTS.

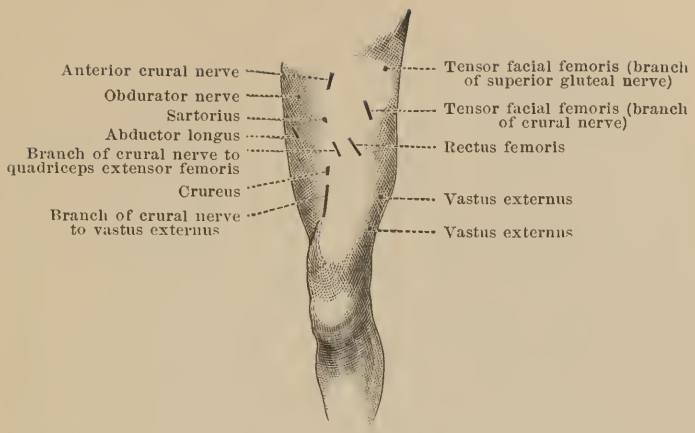

Fig. 10.— Ziemssen's Motor Points.

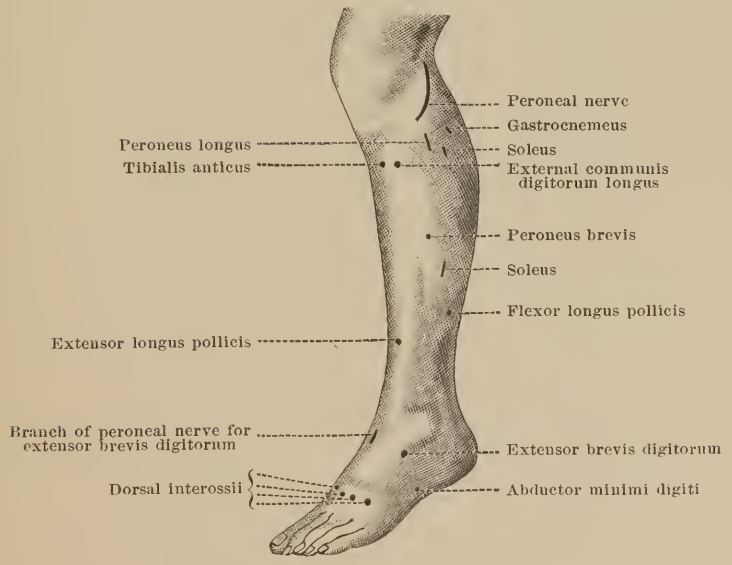

Fig. 11.— Ziemssen's Motor Points.

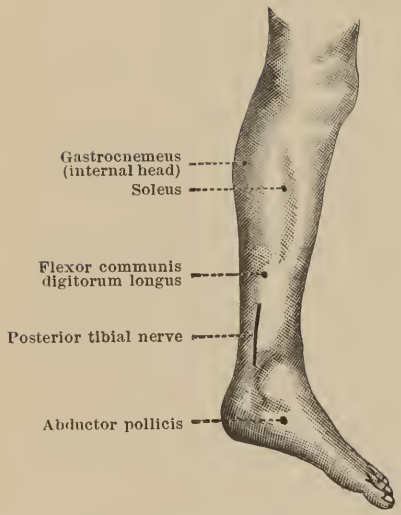

Fig. 12.— Ziemssen's Motor Points.

rather to a peripheral cause, also show a decrease or complete failure of electric reaction.

Motor Points. By the indirect method of electric stimulation, not only a large number of muscles supplied by a nerve trunk can be simultaneously thrown into contractions, but also deep-seated muscles can thus be reached. To accomplish this purpose, it is necessary to determine the locality of the accessible motor nerves, or rather the so-called "motor points."

The annexed figures showing these motor points are reproduced from the works of Ziemsen and Erb.

Electro-Therapy.

Very little of a positive character can be advanced in explanation of the *modus operandi* of electricity as a remedial agent. In fact, its therapeutical reputation rests for the most part on empirical grounds. To say that the curative properties of the electric current depend upon the stimulant effect it exerts on nerves and muscles, conveys but a limited conception of its action. All that experience teaches is the simple fact that certain pathological conditions are modified under the influence of electricity in some undetermined manner. Remak ascribes this influence to the *catalytic* action of the current affecting the vaso-motor and trophic nerves; Erb, to its *electrolytic* effect on the molecular and chemical changes of the organic tissues. There is reason to conclude, from a large number of observations, that the electrotonic effect of the current is of wide application in the treatment of diseases requiring an energetic nervous excitation. The "refreshing effect" of electricity in tired-out muscles is probably of that nature.

The Polar Method. Eminent observers maintain that the influence of the current is determined by its direction. A current is said to be "descending" when it flows from the center to the periphery, *i. e.* when the kathode is nearest to the muscle; and "ascending" when the current flows in the opposite direction, *i. e.* when the anode is nearest to the muscle. The balance of opinion appears to incline in favor of the "polar method." This method answers every practical purpose, and besides allows the choice of either the excitant effect of the negative pole, or the sedative influence of the positive pole. It offers also the decided advantage of localizing a current of the required

density. The latter consideration is of no little moment, for the rule in electro-therapy is to apply the current in *loco morbi*, and to intensify its action at "the point of election." We have seen that the maximum strength of a current is at the point of its greatest density. In sending a current into the body, several ways are offered by which a current of sufficient density can be transmitted to the affected part. If it be desired to apply the current to a part near the surface of the body, it is advisable to select medium electrodes, and place them close to each other. This procedure is well adapted to the electrisation of large muscles. If a part lies deeper, a small "active" electrode is placed as near to it as possible, and the "indifferent" electrode of larger size is applied to a distant part. When a very deeply seated organ is intended to be stimulated, as, for instance, the spinal cord, the rule is to select electrodes of very large size, which should be placed wide apart from each other. In reference to the choice of the poles, it is best to follow the advice of De Watteville: "Whenever the expected result does not follow the influence of the theoretically indicated pole, the contrary pole is to be tried."

Practical Remarks. No special rules can be laid down in reference to the choice of currents. The therapeutical effect of either is frequently the same in many cases. The galvanic current is superior to the faradic in diseases due to nutritive changes and in disorders like hyperæsthesia, neuralgia and spasms, which result from hyperexcitability. Different methods of applying the current are advantageously used in certain diseases. There is the "stabile" current, which signifies undisturbed electrisation; the "labile" current, which means repeated removal and replacement of one of the electrodes. Frequent reverses of the poles—the so-called "Voltaic alternatives"—intensify the continuous current. Dabbing an electrode on the surface is another way of applying the labile current.

An overdose of electricity always does harm. There is no better way of becoming familiar with the different strengths of the current than to practice on one's self. The faradic current is preferable for exciting muscular contractions and to stimulate the skin. It is, therefore, much employed in motor and sensory paralysis.

The pain on electrising the face is mitigated by dusting the part with toilet powder. In order to avoid the pain which is caused on using a strong galvanic current, it is advisable to switch in the desired number of elements, a few at a time, and to exclude them in

the same manner before the removal of the sponges. A firm, steady pressure on the electrodes produces less pain than holding them lightly to the skin.

Dry sponges or the uncovered disks, and, better still, the electric brush when powerful stimulation is indicated, suit applications to the skin. To act upon motor nerves and muscles wet sponges should be used. Sometimes there is little or no response to the galvanic current until the sponges and the skin are well moistened with warm water to which salt has been added.

Daily sittings are required where the cumulative effect of the stimulation is desired. The duration of a sitting varies, according to circumstances, from two to fifteen minutes. General electrisation should occupy at least twenty minutes.

Batteries require constant care to keep them in good working order. In most instances, when an induction apparatus loses its force, it is due to the rust which collects on the hammer. The fluid requires frequent renewal. Defect in the different connections weakens or arrests the current.

General Galvanisation. This manner of applying the current is intended to influence the nerve centers. The positive pole is passed from the forehead and vertex down the whole length of the spinal column, while the negative pole is held to the pit of the stomach or the sacrum. Care must be taken to graduate the strength of the current. A weak current should be applied to the head for a few minutes. General galvanisation has been found beneficial in neurasthenia, insomnia and analogous functional disturbances of a cerebral character.

General Faradisation. This practice was introduced by Drs. Beard and Rockwell, of New York. The patient is seated on a low stool, his feet resting on a large electrode to which the negative pole is attached. With the other electrode every part of the body from the head to the soles of the feet is electrised. Unnecessary pain is avoided by the regulation of the strength of the current. General faradisation exerts an electrotonic effect, due to its action on the muscles and the circulation. Benefit is derived from its use in states of general debility from constitutional causes.

The Electric Bath. One of the poles of a strong induction current is placed in the bath tub, wherein the patient is immersed above his shoulders. The other pole is applied to different parts of the body.

The addition of salt or acid to the water rather lessens than favors the penetration of the current. The electric bath is only another form of general faradisation.

The Electric Hand. This method is chosen for stimulating the face of timid or sensitive persons. One sponge is held by the patient, the other by the physician. The latter places the palm of his free hand upon the well-dried forehead of the patient. Moistening the hand or fingers has a more energetic effect.

CHAPTER IV.

SPECIAL PATHOLOGY AND THERAPEUTICS OF NERVOUS DISEASES.

Neuralgia.

Neuralgia denotes a characteristic pain which results from a variety of causes. Although for this reason it should be viewed in the light of a symptom, still there are weighty considerations that vindicate for it the claims of an individual disorder. In the first place, the clinical features of neuralgia indicate a peculiar morbid condition of sensibility, frequently of an obscure origin, and then pain is always an object of treatment. Neuralgic pains are limited to definite nerve paths, and spontaneously recur in paroxysms of great vehemence. Patients usually describe the pain in the strongest language. It is darting, shooting, lancinating, etc., and marked by remissions and exacerbations. Complete intermissions are typical of neuralgia. The existence of painful spots in the course of the affected nerve is another peculiarity of neuralgia, though occasionally they are absent. These "puncta dolorosa" are usually found in places where the nerves pass through bony canals, or penetrate the fasciae of muscles. During the paroxysm it is not unusual for the pain to radiate to other branches of the same nerve trunk. In more rare instances, the pain appears to be translated to the opposite symmetrical nerve, and sometimes to nerves in remote parts of the body.

Complications. These are principally due to associated motor and vaso-motor disturbances. In the neuralgia of mixed nerves, as in sciatica, the same morbid cause which gives rise to the pain may simultaneously induce motor irritation in the forms of fibrillary movements and cramps. After the subsidence of the latter, some degree of muscular weakness is often noticed. But the motor irritation is sometimes of a reflex character. This is well exemplified by the convulsive movements (tic) of the facial muscles in neuralgia of the trigeminus. The implication of the vaso-motor nerves is

inferred from the pallor and subsequent redness of the skin and mucous membranes. Of the same import are the secretory disturbances affecting the saliva, tears and nasal discharge. Trophic disturbances, under similar circumstances, cause the appearance of cutaneous eruptions, atrophy of the skin and subcutaneous fat, and the stunted growth of the hair and nails.

Etiology. Heredity constitutes an important etiological factor in many cases of neuralgia. This is evident from the frequent occurrence of allied neuroses, such as epilepsy, hysteria and convulsive attacks, among the members of the same family. It is assumed that some congenital abnormality of the nervous system predisposes such persons to this class of disorders.

Age and Sex. Children of a tender age are rarely the subjects of neuralgia; nor is it a common affection in persons past the middle period of life; but elderly people are sometimes afflicted with a most terrible form of facial neuralgia, which probably depends upon senile changes of the arteries. Neuralgia is most frequent between the ages of twenty and forty years. Females suffer oftener from it than males.

Anæmia. General anæmia and the chlorotic diathesis act decidedly as predisposing causes of neuralgia. The impoverished state of the blood, and the consequent mal-nutrition of the body, weaken resistance to the obnoxious influences that favor the development of neuralgia.

Nervousness. This is not the place to discuss the subject of nervousness and its aggravated or peculiar manifestations, such as hysteria, hypochondriasis, spinal irritation and neuræsthenia. It suffices to allude here to the common experience that but few patients who suffer from any of these disorders are exempt from neuralgic pains. The period of puberty in females has a similar tendency to develop neuralgia. This must be attributed to the profound influences at this epoch of woman's life that particularly react upon the nervous system.

Traumatic and Analogous Causes. Neuralgia from injuries to sensory nerves is well illustrated in those instances where the stump of an amputated limb becomes the seat of exquisite pain. The irritation set up by tumors and diseased bones is frequently followed by a like effect. Neuromatous growths, and the so-called "painful

tubercle," are also sources of local neuralgia. Rheumatic or atmospheric influences must be charged with causing genuine neuralgia, as its occurrence may often be directly traced to exposure to cold and dampness. Weir Mitchell describes a form of neuralgia (causalgia), resulting from gunshot wounds, which is marked by an unbearable pain, not only at the seat of injury, but also in the course of the affected nerve trunk.

Toxic Causes. Neuralgia of a regular periodical type is characteristic of malarial influence. The supraorbital branch of the fifth pair of nerves is the favorite seat of this form of masked intermittent. Nocturnal pains, affecting by preference the scalp and lower extremities, suggest the existence of constitutional syphilis. Lead poisoning gives rise to peripheral as well as to visceral neuralgia. In a case of this kind which came under my observation, the pain was located in the forearm, the shoulder and the cervico-occipital region of the same side. The neuralgia immediately succeeded an attack of colic.

Diagnosis. By strictly adhering to the accepted definition of neuralgia, much embarrassment in its diagnosis may be avoided. The pain of neuralgia is of a remittent or intermittent character, of extreme violence, and usually coming on without an assignable cause. It is confined to the course of a nerve or involves more or less extensively the distribution of a nerve trunk. The existence of "painful spots" along the affected nerve paths, and especially vaso-motor disturbances, are of great diagnostic value. Whether a neuralgia is of central origin or not, must be decided by the history of the case and its concomitant symptoms.

Treatment. The difficulties encountered in the treatment of neuralgia relate, principally, either to the obscurity of the seat and nature of the irritation, or to our inability to remove the cause in cases where it is well understood. A morbid tendency, whether constitutional or acquired, that favors the development of neuralgia, frequently opposes our best directed efforts for its permanent cure. But, in general, it may be said that among all the functional diseases of the nervous system, none yield more frequently or readily to therapeutical measures than neuralgia. Cases which allow of surgical interference promise satisfactory results. Thus foreign bodies and necrosed bones may be removed, cicatrices split or excised and neuromatous tumors extirpated. Neuralgia occurring at regular periods, whether due to malaria or other morbid influences, indicates the administration of quinia or

arsenic. Pains of syphilitic origin are successfully treated by potass. iod., or mercury. The former remedy is often found beneficial in rheumatic and saturnine neuralgias. Iron has a deserved reputation in all varieties of neuralgia which are liable to develop in anæmic and chlorotic patients. Of all the different remedies, none stand in higher repute in the treatment of every form of neuralgia than opium or its preparations; and next in rank, belladonna, or rather atropia. The frequent resort to this class of medicines is due to the necessity of adopting a symptomatic treatment in numerous cases. Among the many empirical remedies in vogue, there are undoubtedly some that do not owe their reputation to mere coincidences. Arsenic, in the form of Fowler's solution, commencing with five drops three times a day after meals, should always have a fair trial in chronic cases. The tinct. of gelsemium sempervirens in doses of fifteen drops, frequently repeated until its physiological effects become apparent, seems to be of occasional benefit in neuralgia affecting the dental branch of the trifacial nerve. Phosphorus and turpentine have sometimes proved beneficial in inveterate cases. The latter remedy must be given in large doses.

A systematic course of tonic and supporting treatment is of prime importance in all instances of neuralgia traceable to nervous exhaustion. Sufficient rest and plenty of digestible food constitute here the indispensable adjuvants of successful treatment.

The prompt action of sedative remedies for the relief of neuralgic pain can now be readily obtained by the use of the hypodermic syringe. This mode of administering morphia and atropia is, therefore, preferable whenever the patient offers no particular objection. Stimulant and anodyne liniments, variously combined, are much employed in the lighter forms of neuralgia; but blistering is undoubtedly of superior value. For this purpose, the cantharidal collodion is to be recommended, which can be applied with a brush to any part of the surface. Electricity is occasionally of great service. Its remedial effects, according to Duchenne, are also observed when the electric brush is placed at a short distance from the painful part. The constant current is, however, preferable. Daily applications of from ten to fifteen minutes are required. The anode is applied to the painful nerve, and the kathode to an indifferent part of the body. Recent trials of nerve-stretching, for the relief of severe and inveterate cases of neuralgia, have been followed by a measure of success which justifies the adoption of this surgical procedure in appropriate cases.

Facial Neuralgia. Neuralgia affecting the different divisions of the trigeminus is of frequent occurrence. This is especially true of the ophthalmic branches. Malaria and atmospheric influences are accused of constituting the most common causes of this form of neuralgia. The "brow ache" is said to be notoriously common in malarial districts. In neuralgia of the head, it is advisable to search for stumps of decayed teeth and a crowded wisdom tooth.

The most constant painful spots in the distribution of the ophthalmic division of the trigeminus are found in the region of the supra-orbital notch, on the upper eyelid, the inner angle of the eye and at the parietal eminence. In the course of the superior maxillary, a focus of pain is found at the infra-orbital foramen and another in the region of the malar bone. In the inferior maxillary division, it is usual to meet with the temporal and the inferior dental puncta dolorosa.

The vaso-motor disturbances, which are particularly common in facial neuralgia, consist of strong pulsation of the temporal arteries, reddening of the conjunctiva, increased secretion of the lachrymal and salivary glands and of the nasal mucous membrane. Motor disturbances of a reflex character, involving groups of muscles of the affected part of the face, are also frequently noticed in the form of spasmodic contractions. (Tic convulsif. Blepharo-spasm.) Severe and inveterate cases of facial neuralgia exert an injurious influence on the general health in consequence of constant suffering and loss of sleep.

Treatment. Quinia and salicylate of soda in large doses, and, in obstinate cases, the persistent use of arsenic, often prove of great efficacy. Sometimes a combination of morphia and quinia gives excellent results. From personal experience, I can speak favorably of the veratria ointment in cases of moderate intensity. In that exceedingly distressing variety of facial neuralgia occurring in elderly people, scarcely anything else can be done to afford relief than repeated injections of morphia. Much may be expected in well-selected cases from potass. iod. The cautious use of the galvanic battery sometimes yields surprisingly good results. It is in facial neuralgia that nerve-stretching has been most frequently tried with an encouraging degree of success.

Hemicrania (*"Migraine," Sick-Headache*). This disease is now considered an angio-neurosis. A number of its symptoms evidently

result from vaso-motor disturbances. Painful spots are wanting, though the scalp is very sensitive to the touch. Only one side of the head is affected, and, singularly, it is the left side which suffers in the majority of cases. The pain may be chiefly felt in the frontal, parietal or occipital region. The onset of an attack is occasionally preceded by shuddering, sighing and yawning. Its duration is variable, but is rarely prolonged beyond twelve hours. Nausea and vomiting frequently supervene, without, however, mitigating the pain. There is much nervous depression and a strong inclination to sleep.

Hemicrania is an affection of frequent occurrence in the female sex. It often dates from early childhood. Heredity and the period of puberty constitute the chief predisposing causes.

Diagnosis. The clinical history of hemicrania is sufficiently well marked to obviate diagnostic difficulties. A first attack of great severity may cause embarrassment for a short time. It must be distinguished from "clavus hystericus."

Treatment. Considerable relief is obtained during the violence of an attack from the application of cold to the head. Morphia, in the form of hypodermic injections, does not allay the pain as promptly as it does in true neuralgia. The effervescent citrate of caffein in teaspoonful doses, or bicarbonate of soda in large draughts of hot water, will occasionally stop the retching and vomiting. From ten to fifteen grains of quinia, promptly administered at the very onset of the paroxysm, sometimes succeeds in cutting it short. Guarana in doses of fifteen grains, frequently repeated, also deserves a trial. Good results may be expected from the inhalation of nitrate of amyl in that variety of migraine which appears to be due to spasmodic vascular constriction.

Occipital Neuralgia. The two upper cervical nerves are distributed to the whole of the occipital and also partly to the parietal regions. Branches of the third and fourth cervical go to the lower portion of the cheek, to the side of the neck and to the supra-clavicular region. As these nerves are more or less simultaneously involved, it is usual to speak of cervico-occipital neuralgia. Care must be taken not to confound it with the pain attending caries of the cervical vertebræ. Occipital neuralgia is commonly of great severity. The affected parts are extremely sensitive, the slightest movement of the head being apt to bring on a paroxysm of pain. The most constant painful spot is found about the superior portion of the occipital prominence.

Treatment. Local measures in the form of wet cups, or better still, repeated blistering, constitute the most approved treatment. The galvanic current of about thirty elements directly applied to the parts rarely fails to give relief. Morphia, to allay the violence of the pain, cannot easily be dispensed with in severe cases.

Brachial Neuralgia. This comprises a large group of neuralgias which severally affect the cutaneous distribution of the ulnar, the median and radial nerves that collectively proceed from the brachial plexus. Isolated neuralgias may occur in the shoulder, the scapula, the upper arm, the elbow, the forearm, the wrist, hand and fingers. Among the most constant painful spots may be mentioned a point where the radial curves around the humerus; and another in the course of the same nerve near the wrist. Occasionally an upper ulnar point between the olecranon and the internal condyle, and a median point at the bend of the elbow, may be detected.

Motor and trophic disturbances frequently complicate this form of neuralgia. The former consist of cramps and twitching of muscles, and the latter of cutaneous eruptions near the seat of the pain.

A rheumatic influence is probably the most common exciting cause of the neuralgia. The superficial situation of the radial and ulnar nerves exposes them to direct injury.

An instructive example of the singular complications that sometimes attend injuries to cutaneous nerves came under my notice at the Baltimore City Hospital. The patient, a young Irish woman, presented herself with a stiff, painful arm, much swollen at the elbow and covered by large blebs resembling pemphigus, which extended from the wrist to the shoulder. The house surgeon had observed a few black spots near the turn of the radial nerve on the upper arm that proved to be the ends of large sewing needles. The girl confessed afterwards that she had designedly pushed them in for the purpose of being admitted into the hospital. The treatment of brachial neuralgia is conducted on the same principles as the foregoing variety.

Dorso-Intercostal Neuralgia. The superficial branches of the seventh, eighth and ninth pairs of dorsal nerves, which run in the direction of the intercostal spaces, are usually affected in this variety of neuralgia. Painful spots are found in the region where these nerves emerge from the intervertebral foramina, at the bend of the ribs and near the junction of the cartilages and the sternum.

Nervous and anæmic women are exceedingly liable to suffer from a neuralgic pain beneath the left mamma. It is often associated with spinal tenderness.

The frequent association of herpes zoster with dorso-intercostal neuralgia is an interesting fact, as it points to the neurotic origin of the cutaneous eruption. It appears that the source of irritation which affects the sensitive fibres also implicates the vaso-motor branches distributed to the same region of the body.

Intercostal neuralgia must not be confounded with pleurodynia. This phrase is often used to designate a diffuse pain affecting the thoracic walls, which is of a rheumatic or, rather, a myalgic character. There seems to be a causal relation between uterine and ovarian trouble and intercostal neuralgia. Diseases of the vertebrae and spinal cord are frequently attended by a neuralgic pain in the dorso-lumbar region and parts of the chest.

Treatment. Constitutional as well as local treatment is indicated. My own experience speaks highly in favor of strapping the parts with strips of adhesive plaster, as it is practiced in fracture of the ribs. Stimulant liniments are useful in cases of moderate severity. The violence and persistence of the pain which often accompanies the development of shingles require morphia. The vesicles should not be disturbed by friction with ointments.

Lumbar Neuralgia. The branches of the lumbar plexus are comparatively but seldom the seat of neuralgia. Those parts to which the ileo-inguinal, the ileo-hypogastric and the genito-crural nerves are distributed are most frequently affected. They comprise the back, the mons veneris, the labia, the scrotum, the inner side of the upper portion of the thigh and the inner edges of the knee, foot and big toe. Neuralgia of the obturator nerve deserves particular attention, as it is symptomatic of strangulated hernia within the obturator foramen.

Sciatica. This is one of the most frequent forms of neuralgia. The great length of the nerve and its extensive distribution subject it to numerous morbid influences, and, in addition, the sacral plexus may become involved in intrapelvic diseases. The pain in sciatica is usually of great severity, and, as a rule, reaches its maximum of intensity at once. A renewal of the pain may at any time be brought on by flexion of the limb; hence the patient instinctively adopts a peculiar stiff gait. Sciatica is occasionally complicated with tremor

and cramps of the affected extremity, and sometimes wasting of the muscles is noticed. Hyperæsthesia is a constant concomitant, though numbness and a furry feeling of the parts may be associated with it.

The painful points are numerous, and some are constantly present. A tender spot corresponding to the trunk of the nerve between the great trochanter and the tuber ischii is seldom wanting. There is a fibular point along the superficial course of the peroneal nerve, and an external and internal malleolar point.

Age and sex appear to exercise some influence in the causation of sciatica. The disease occurs most frequently in the middle period of life, and is decidedly more common in the male than in the female. It is also noteworthy that the right leg is affected oftener than the left. In general, it may be said of sciatica that it is far less frequently due to constitutional causes than other forms of neuralgia. In most instances the neuralgia results either from injury or exposure to the combined influences of cold and dampness. Among the special exciting causes should be mentioned: Tumors within the pelvis, which irritate or compress the sacral plexus; displacements of the uterus; diseases of the rectum; impacted fæces; protracted labors; forceps delivery; popliteal aneurism; morbid growths in the course of the sciatic nerve, and hæmorrhoids. Double sciatica is an early symptom of locomotor ataxy.

Recent cases of sciatica readily yield to a judicious treatment, but chronic cases often prove very obstinate and relapses are common. Some degree of stiffness and feeling of tiredness in the limb often persist for weeks and months after recovery.

Treatment. The possible removal of the exciting cause constitutes the primary indication of treatment. In those instances where such a procedure is impracticable, palliative measures form the only resource. The hypodermic injection of morphia is, perhaps, the only reliable means of allaying the pain during the severity of the paroxysm. Iodide of potassium and strychnia, in appropriate doses, are highly recommended, especially in cases of long standing. Turpentine is an old remedy in sciatica, which occasionally proves serviceable. I witnessed its good effects in the case of a seaman at the City Hospital, who took the drug twice, in half-ounce doses, with perfect relief of the neuralgia that had troubled him for the past four months. Moist packing has been strongly advised by Rosenthal. I was favorably impressed with the results it yielded in cases where this

treatment was adopted; but it is generally agreed that blistering is, after all, the most promising mode of local treatment in the majority of cases. I am partial to the use of the cantharidal collodion. Galvanisation always deserves a trial, as it sometimes succeeds in effecting a cure when all other remedies fail. Anstie and Eulenberg assert that sciatica is more frequently cured by the constant current than any other species of neuralgia.

Spermatic Neuralgia ("Irritable Testicle").

The external genital organs in both sexes are remarkably free from neuralgia; but the male is subject to very violent and intractable paroxysms of pain which start in one of the testicles and extend to the spermatic cord. This species of neuralgia is better known by the name of "irritable testicle." During an attack the testicle is retracted and the scrotum is exceedingly sensitive to the touch and appears slightly swollen.

Such is the impotency of therapeutics in this form of neuralgia that desperate measures have been proposed for its cure.

Hammond advises to keep up a pressure for fifteen minutes on the spermatic cord to crush the axis cylinders of the nerve. The application of ice to the scrotum gives only temporary relief. Perhaps galvanisation, which is now urgently recommended for this disorder, may have greater success.

Angina Pectoris.

Until the pathology of angina pectoris is better understood than it is at present, there is no impropriety in classifying this disorder among the group of visceral neuralgias; at least its most prominent symptom consists of paroxysmal attacks of intense pain in the region of the heart. But associated with this pain are disturbances of circulation and respiration which do not enter into the definition of neuralgia. It has therefore been suggested that the set of symptoms comprised under the name of angina pectoris may rather be of the character of a neurosis affecting the sympathetic nerves that form the cardiac plexus. Physiological investigations appear to favor this view.

Clinical History. Attacks of angina pectoris come on at irregular periods. Suddenly a pain of terrible intensity strikes the cardiac

region, rapidly spreads over the left side of the chest and sometimes extends to the arm. Along with the pain there is a sensation of constriction and a peculiar dread of impending dissolution. The heart beats violently at first, but at the height of the paroxysm its action becomes irregular, intermittent, and then appears to cease altogether. Analogous changes in the condition of the pulse are observed. The respiration is hurried and panting, or suppressed; the latter symptom is owing to the effort of the patient to stay the pain by holding his breath. To complete this picture of physical suffering and mental anguish, the skin becomes pallid and cold, the face appears sunken, and a clammy perspiration breaks out on the surface at the close of the attack. A single paroxysm lasts but a short time, but there may be several attacks in quick succession.

Etiology. There is a form of angina which accompanies hypertrophy and fatty degeneration of the heart, valvular disease and calcification of the coronary artery. In other instances no lesion is discovered to account for the symptoms during life. The excessive use of tobacco is blamed for causing an irritability of the heart that is eventually destined to develop the affection. Mental shocks, gastric and intestinal disturbances are mentioned as exciting causes. Advanced age has a predisposing influence. Men are more liable to suffer from the attacks than women.

Course and Termination. The course of the disease is always chronic. Attacks are of variable frequency. There may be a respite for years or a daily repetition of the paroxysms. In rare instances they cease spontaneously. Many patients live to an old age, but a person subject to angina is in imminent danger of death at every new onslaught.

Diagnosis. Angina pectoris is easily recognized by the character of the intra-thoracic pain and its concomitant symptoms; but whether in individual cases the affection is due to structural disease of the heart is not so readily determined as may be supposed. Calcification of the coronary arteries is simply impossible to recognize, and fatty atrophy of the heart does not give rise to symptoms upon which a reliable diagnosis can be based. Now, these organic affections of the heart are, above all others, most frequently associated with angina.

Of hardly less importance is the differential diagnosis between pseudo-angina pectoris and the genuine affection. Walshe correctly observes that the imitation is of far more frequent occurrence than

the true disease. The symptoms of pseudo-angina, as described by this author, are "more or less severe pain referred to the region of the heart, commonly constrictive palpitations occurring paroxysmally without obvious cause, or under exertion, or through over-eating, indigestion, flatulent distention of the stomach and a variety of other functional disturbances. The breathing becomes panting and sighing. Giddiness and faintness are sometimes observed. The patient dreads efforts of all kinds."

Treatment. A fit of angina bears such a close resemblance to the phenomena of shock that sedatives and stimulants appear to be urgently called for. In fact, the safest treatment during an attack consists of the administration of laudanum and brandy in quantities proportionate to the severity of the symptoms. The good effect of these remedies may be sustained by repeated doses of aromatic spirits of ammonia and the application of sinapisms to the chest and between the shoulders. It is very risky to administer chloroform or even ether. The cautious inhalation of nitrite of amyl is preferable.

As a precautionary measure, the patient must avoid all exciting causes that may induce a recurrence of the paroxysm. His own experience will probably teach him to guard against the injurious influence of a hasty, ill-digested meal, irregularities of the bowels and undue exertion. Equanimity of mind and evenness of temper prove no less serviceable as preventives.

Very little confidence can be placed in the efficacy of internal medication for the cure of the angina. Iron holds out the best chance in cases associated with anæmia. Duchenne achieved some success from cutaneous faradisation of the cardiac region in a case which was not complicated with organic heart trouble.

Headache.

As headache is merely a symptom, it follows that its clinical importance must be rated in accordance with its prominence and association with other phenomena. Thus all febrile affections and many diseases of the brain and the meninges are attended by headache. Pain in the head occurs, however, under circumstances which render it an object of special treatment. The character of the pain varies from a mere feeling of heaviness in the head to paroxysms of great violence.

In attempting to classify the different varieties of headache, it must

be understood that only the more ordinary forms are intended to be discussed. Facial neuralgia and hemicrania have already been described. The headaches characteristic of cerebral hyperæmia and anæmia will be referred to in their proper places.

Nervous Headache. Exhaustion of the nervous system from any cause or combination of causes is a fruitful source of manifold disorders, not the least of which is an exceedingly harassing headache, which is commonly attended by a hypochondriacal state of mind. There may be no actual pain in the head, but there is a distressing sensation as if the head were compressed by a vice or crushed in from the top. Insomnia usually attends this troublesome symptom. Patients declare they will "go mad" if they get no relief, and some actually exhibit signs of insanity.

The treatment must be directed to the abandonment, on the part of the patient, of all debilitating influences that tend to undermine the general health. Measures should be adopted which invigorate the nervous system. Temporary relief of the headache is sometimes obtained from sweet spirits of nitre, Hoffman's anodyne, chloric ether and aromatic spirits of ammonia, either singly or variously combined. General faradisation is highly recommended by Beard and Rockwell.

Rheumatic Headache. Exposure to draughts of cold and moist air, when the head and neck are not well protected, occasions a form of headache which is diffused over the scalp, and may extend to the back and shoulders. Movement of the head aggravates the pain.

Wrapping the head in a woollen shawl and keeping quiet affords relief. A Dover's powder should be given at bed-time to induce sleep. Severe cases are often benefited by salicylate of soda.

Syphilitic Headache. Constitutional syphilis gives rise to a violent form of headache marked by nocturnal exacerbations. When such a pain in syphilitic patients does not depend upon pericranial disease or necrosed bones and is attended by insomnia, it may be the forerunner of serious implication of the brain and meninges. Very large doses of the potass. iod. should be promptly administered in cases of this kind.

Dyspeptic Headache. The headache resulting from gastric and intestinal disturbances is probably of a reflex character. Popular pathology ascribes nearly every form of headache to "biliousness or dyspepsia." That pain in the head is frequently a symptom of

indigestion and torpidity of the bowels cannot be gainsaid; but it is far from true that the majority of headaches own such an etiology.

Should a brisk action of the bowels be indicated, there is nothing more reliable than the compound infusion of senna. A warm aloetic pill, when hemorrhoids are not in the way, is a good derivative. A foul tongue is easily cleansed by bicarbonate of soda.

Habitual Headache. The so-called habitual headache is the most wide-spread and intractable of all species of headache. Its paroxysmal occurrence has been quaintly termed a "nerve storm." Probably some congenital or hereditary tendency predisposes to its occurrence. There are people who are never without a headache.

Absolute rest and quiet when an attack of more than usual intensity comes on give greater relief than anything else. Quinia aggravates the pain, and the continual use of morphia is objectionable. The monobromate of camphor in pills, from three to five grains, is occasionally of benefit. Among the empirical remedies may be enumerated caffein, thein, guarana, arsenic, the bromides, turpentine, and strychnia.

CHAPTER V.

PERIPHERAL PARALYSIS.

Traumatic Paralysis. Injuries to nerves from excision, laceration, contusion, etc., give rise to complete forms of peripheral paralysis. Lighter forms result from mechanical causes that compress a nerve, as sitting upon the edge of a hard substance for a considerable time, or lying on an arm crossed behind the back during sleep.

Rheumatic Paralysis. This constitutes the most common form of peripheral paralysis. It is ascribed to "cold" or atmospheric influences. Nothing definite is known respecting its pathology, though the paralyzed nerve must evidently have undergone some morbid alteration.

Toxic Paralysis. A large number of poisonous substances cause paralysis when introduced into the general system. It suffices to mention lead, arsenic and mercury. Lead palsy usually makes its appearance subsequent to attacks of colic. In cases where the paralysis appears to be the first symptom, the other signs indicative of the presence of the poison may have been noted for some time, viz.: the blue line of the gums, the obstinate constipation of the bowels and the dry skin. The paralysis is often preceded by vague neuralgic pains in different parts of the body, more or less attended by numbness, formication, tremor and twitching of the muscles. In the majority of cases the extensors of the forearm become paralyzed, presenting the appearance popularly known as "wrist drop." All the muscles supplied by the musculo-spiral nerve may become successively paralyzed; but it is singular that the supinator longus generally remains intact. The deltoid, and more rarely the serratus magnus, is occasionally involved, either singly or in combination with the extensors of the forearm. Atrophy of the paralyzed muscles rapidly ensues. Electric exploration gives characteristic results. In many cases there is an entire loss of electro-muscular contractility; but generally the electric excitability corresponds in degree to the amount of nutritive changes which the affected muscles have undergone.

In the treatment of lead palsy, as in all cases of peripheral paralysis, the application of electricity holds out the best promise of a cure. Iodide of potassium is recommended for the purpose of eliminating the poison from the system. This is perhaps better accomplished by frequent hot baths, which stimulate the cutaneous surface and increase its secretions. The patient must be warned against future exposure to the deleterious influence of the metallic poison.

Paralysis following Infectious Diseases. Paralysis is occasionally observed during the convalescence or after the complete subsidence of acute infectious diseases. It may thus occur as a sequela of diphtheria, typhoid fever, scarlatina, measles and variola.

Diphtheric Paralysis is apt to develop from the third to the fourth week after the termination of the primary disease. The muscles of the soft palate are the first to suffer. This is indicated by the nasal character of the voice and difficulty of deglutition. When the muscles of the eye become affected, they cannot properly perform the function of associated movements. Strabismus is of rare occurrence. Paralysis of the extremities takes on the form of paraplegia. Diphtheric paralysis yields a favorable prognosis. Recovery may be hastened by quinia and cod liver oil.

Paralysis is the most frequent symptom of syphilitic lesions of the nervous system. As this subject will be considered more in detail in its proper place, it is at present only necessary to mention that certain cranial nerves are particularly prone to become paralyzed. Thus paralysis of the levator palpebrarum superioris (ptosis) is considered almost pathognomonic of cerebral syphilis.

Ischæmic Paralysis. By this term is now understood a form of paralysis which depends upon an obstructed supply of arterial blood to the nervous apparatus. The hemiplegia resulting from thrombosis and embolism of the cerebral arteries is a good example of ischæmic paralysis. But cases have been observed in which obliteration of an arterial trunk, or the existence of an aneurism in various parts of the body, gave rise to peripheral paralysis. Charcot relates the following instructive case: A patient was affected with paralysis of the right leg whenever he attempted to walk, but the paralysis would disappear after he had rested for a few minutes. The autopsy revealed an aneurism of the right iliac artery; the inferior third of the vessel had been converted into a ligamentous cord, and both divisions of the main trunk were, in comparison to those of the other side, considerably narrowed in their calibre.

Acute Neuritis. The paralysis following acute neuritis is due to an inflammatory process which invades the constituent parts of a nerve. The anatomical changes consist of swelling of the nerve, enlargement of its capillaries and the presence of hemorrhagic spots in its tissue. The medullary matter disappears and the axis cylinder becomes granular and atrophies. Considerable febrile excitement marks the onset. Intense pain is felt along the course of the nerve and its distribution. The nerve is swollen and extremely sensitive to the touch. Anæsthesia and loss of reflex excitability of the parts may take the place of hyperalgesia. Paralysis of the muscles supplied by the affected nerve rapidly follows. An acute progressive neuritis has lately been described which is said to involve a large number of nerves in different parts of the body.

Chronic Neuritis has the same etiology as the acute variety, and sometimes develops from the latter. The connective tissue of the neurilemma is greatly increased and compresses the nerve fibres; or the latter may be the principal seat of the pathological changes. Finally the axis cylinder becomes thickened and shrivels, and the medullary substance disappears. The symptoms include sensory and motor disturbances of variable intensity. At first the patient may only experience a feeling of numbness or a furry sensation in the course and distribution of the affected nerve; but very soon the parts become exceedingly sensitive and sometimes paroxysms of violent shooting pains occur. The pain, unlike that of neuralgia, progresses in a centrifugal direction; no puncta dolorosa are found, but the nerve is tender on pressure and appears to be swollen. There is either complete anæsthesia of the parts, or only a creeping and tingling sensation; and, in severe cases, twitching and spasms of the muscles. Paralysis, attended by more or less atrophy of the muscles supplied by the affected nerve, finally ensues. The modifications of electric reaction and the trophic changes are the same as in injuries to nerves.

The treatment of acute neuritis calls for the application of leeches along the course of the nerve, followed by poultices. Immobility of the limb must be secured by splints. The paroxysms of pain can only be effectually relieved by injections of morphia.

The therapeutics of chronic neuritis is directed against the paralysis and the muscular atrophy. Iodide of potassium is the most favored of internal remedies, though it yields in efficacy to electricity. The galvanic current is preferable to the faradic, but the latter may sometimes be advantageously employed.

Special Forms of Peripheral Paralysis.

Paralysis of the Ocular Muscles. The principal causes of paralysis affecting the different nerves distributed to the ocular muscles are atmospheric influences, intracranial syphilis, tumors, injuries of the orbit, lesions of the pons varolii and peduncles of the brain. Each one of the muscles may be involved either separately or in conjunction with others. The muscles implicated in these various forms of ocular paralysis can be accurately determined. This subject forms an interesting chapter in the special department of ophthalmology. It may be stated in general terms that every defective innervation of the external muscles of the eye necessarily interferes with their associated movements and the accommodation of the visual axis. These abnormal conditions are recognized by the development of strabismus and diplopia.

Vertigo is a constant symptom resulting from the unaccustomed visual displacement of objects and the confusion caused by the double images. Closing the eyes stops the vertigo.

The diagnosis, irrespective of the particular nerve or nerves which may be involved, depends upon the site of the lesion, whether it be peripheral or intracranial. Inquiries into the etiology may afford much information. Complications with affections of neighboring cranial nerves indicate a basilar lesion, usually syphilitic. A combination of paralysis of the face and the extremities points to disease of the pons or cerebral peduncles.

Treatment. There is much of sameness in the treatment of peripheral paralysis wherever located. The rheumatic form of ocular paralysis suggests the administration of iodide of potassium, and, of course, the specific treatment promises the best results when syphilis is suspected. Electricity will be found useful in all cases amenable to treatment. Its application, however, requires some caution. Both the faradic and galvanic current must be of moderate strength. The electrodes should be applied over the closed eyelids and near to the insertion of the affected muscles.

Facial Paralysis. The face in complete unilateral paralysis presents a striking and characteristic appearance. This depends upon the immobility of the muscles of expression which are supplied by the seventh nerve. On the paralyzed side of the forehead no wrinkles are visible; the folds of the glabella do not show, owing to inactivity of the corrugator supercilii; the lower eyelid droops and the eye

cannot be voluntarily closed, because of the loss of motion of the orbicularis palpebrarum. Paralysis of the dilators of the nose causes flattening of the alæ nasi. The labio-nasal fold is effaced on account of inaction of the levators. The want of antagonism of the muscles that converge at the corner of the mouth allows the mouth to be drawn towards the opposite side, and hence there occurs deviation of the lips and difficulty of completely closing the mouth. This permits the escape of saliva. For a similar reason the acts of whistling, blowing, spitting and sucking, and the articulation of the labial sounds, are rendered difficult and sometimes impossible. This motionless condition of the muscles of one side of the face becomes particularly apparent when the patient speaks, laughs or cries. Although the masticatory muscles are not affected, there is, nevertheless, much hindrance offered to the chewing of food, which is due to the flabby condition of the muscles of one side of the cheek. Morsels of food lodge between the gums and the cheek, which the patient is obliged to remove with his fingers. Another troublesome symptom is the constant weeping from the open eye. Double facial paralysis is a very rare affection (Diplegia Facialis).

Rheumatic Facial Paralysis. "Bell's Paralysis." That facial paralysis may directly result from a cause which it is customary to designate as rheumatic, is proved by instances where one side of the face suddenly becomes paralyzed from its exposure to a raw wind, whilst sitting near an open window in a railroad car, or standing near a partly open street door. In other cases where no such palpable causes can be assigned, it must be assumed that some obscure atmospheric influences acted upon a person predisposed to this species of paralysis. What morbid changes take place in the affected nerve remain yet to be determined. Those cases in which the nerve becomes involved within the Fallopian canal are apt to be associated with the disturbances of hearing and taste, and occasionally with lateral deviations of the uvula and obliquity of the velum palati.

The onset of rheumatic facial paralysis is abrupt. Nearly all the external muscles of one side of the face are implicated. In the course of the first few months more or less improvement may be expected; but complete restoration of motility is exceptional. Some disfigurement of the features, when the person gives expression to any emotional excitement, can be noticed even in cases which seem to have perfectly recovered. This distortion of the features in bad

cases becomes exaggerated by occasional spasmodic movements and permanent contracture of the facial muscles.

The abnormal electric reactions characteristic of rheumatic facial paralysis are of diagnostic and therapeutic importance. There is no uniformity in individual cases as regards the stage when electric exploration discovers diminution or total loss of the farado-muscular contractility. Absence of the faradic reaction early in the disease is an unfavorable sign, notwithstanding the remarkable fact that the galvano-muscular contractility may at the same time be increased, so that comparatively few elements will suffice to produce vigorous contractions of the paralyzed muscles (*RD*). But many modifications of electric reaction are noticeable during the course of the disease. In the event of progressive degenerative changes taking place in the nerve and muscles, there will finally be no response to either kind of electricity.

Facial paralysis of short duration in infants is sometimes witnessed from the effects of forceps delivery. The infant is unable to take the breast, as it cannot perform the act of sucking.

Syphilitic periostitis and exostosis affecting the base of the cranium often give rise to all the symptoms characteristic of peripheral facial paralysis.

Lesions of the pons varolii produce a similar effect. The facial paralysis is then usually complicated with hemiplegia.

Diagnosis. The diagnosis of facial paralysis mainly turns upon the question of the localization of the lesion. The etiology of the individual case, but more especially the extent of the paralysis and its complications, afford the most reliable information. It is obvious that in paralysis of all the muscles of one side of the face the trunk of the facial must have been caught by a lesion not higher than the pons. If only the muscles of the lower part of the face are paralyzed, then the lesion probably exists in the central ganglia. As a rule, facial paralysis of cerebral origin is complicated with hemiplegia, and the electric reaction of the nerve and muscles is found to be normal. The associated symptoms of deviation of the uvula, and unilateral disturbance of taste and hearing, speak for the situation of the lesion within the Fallopian canal. Complications with paralysis of other cranial nerves point to intracranial disease. The peculiarities of electrical reaction, indicating the nutritive changes of the affected nerve and muscles characteristic of peripheral paralysis, are of great diagnostic value.

Treatment. As electricity is undoubtedly the most sovereign remedy in all forms of peripheral paralysis, and renders every other therapeutical measure superfluous—at least in the large majority of cases—it will only be necessary to indicate its mode of application. The interrupted current sometimes answers the purpose in ordinary cases. A current of moderate strength should be successively applied to the several muscles for a short time. When recent cases do not yield within a reasonable time, then the combined or alternate use of the faradic and galvanic currents should be tried. Cases in which the farado-muscular contractility is abolished are but seldom amenable to any plan of treatment. Galvanisation is preferable in old and obstinate cases, and for the relief of cramps and secondary contractures. The kathode is applied to the paralyzed muscles or to the nerve, and the anode to an indifferent part — the top of the sternum or the nape of the neck.

The application of leeches and fly-plasters to the region of the stylo-mastoid foramen may, perhaps, be of service in very recent cases; but these local measures, and the customary administration of iodide of potassium and strychnia in old-standing cases, cannot replace electricity. Even in those instances where the causal treatment is indicated, as in affections of the parotid glands and otitis, electricity may be advantageously employed after the removal of the primary cause. Syphilitic facial paralysis must be combated by the usual constitutional treatment.

Laryngeal Paralysis.

Motor disturbances, ranging from slight paresis to complete paralysis of the muscles engaged in respiration and phonation, are met with in the larnyx. A single muscle or a group of muscles innervated by a single nerve branch, or a group of muscles supplied by different branches, but associated in some physiological act, may be affected. Paresis of the tensors of the vocal cords, and almost constant symptom of acute catarrh of the larnyx, is principally due to muscular infiltration, and is usually symmetrical. Total paralysis of a muscle or group of muscles is, in the great majority of cases, unilateral and of peripheral origin. Nervous disturbances in the throat, dependent upon disease of the brain or spinal cord, are extremely rare. Tumors of the trachea, œsophagus and mediastinum, or aneurisms of the great vessels of the neck, which press upon the

recurrent laryngeal nerve somewhere in its course to the larynx, are the most common causes of the paralyses of this region. It will be remembered that the inferior laryngeal supplies all the muscles of the larynx, except the crico-thyroid and part of the transversus. The various forms of paralysis, whether affecting the adductors or abductors of the cords, or the constrictors of the larynx, give typical pictures in the laryngoscope and characteristic quality to the voice, which render them easy of recognition.

A loss of the power of co-ordination during phonation is sometimes witnessed in hysterical women, and may easily be mistaken for palsy of the cords; repeated laryngoscopic examinations serve to distinguish this affection from true paralysis.

Spasms of the laryngeal muscles, besides being exhibited in the laryngismus strideolus of infants, occurs in chorea, epilepsy, hydrophobia and strychnia poisoning. Atrophy, especially of the muscles proper of the cords, sometimes occurs in tuberculous patients, and may further be brought about as an effect of long-standing paralysis.

Immobility of the vocal cords from anchylosis of the arytenoid cartilages, after the throat ulcerations of syphilis and typhus, is, happily, not often met with.

Treatment. Besides the casual treatment indicated in laryngeal paralysis, much assistance is obtained from the employment of electricity. Brilliant results are sometimes witnessed from the interrupted current in hysterical aphonia. The sponges should be applied to the side of the neck which corresponds to the location of the vocal cord. By means of McKenzie's electrode the affected cord can be directly stimulated.

Paralysis of the Sterno-Cleido-Mastoideus and Trapezius Muscles.

Both these muscles receive motor branches from the spinal accessory and the cervical plexus. Prolonged mechanical pressure of the parts has been known to produce isolated paralysis of these muscles; but in the greater number of cases in which no traumatic causation can be assigned, the paralysis must be ascribed to a rheumatic influence. In one-sided paralysis of the sterno-cleido-mastoid, the head is inclined to the healthy side and the chin is directed towards the affected side. The deformity can be easily corrected by passive movements of the head. Atrophy, and finally contracture of the

paralyzed muscles, ensue in long-standing cases. The differential diagnosis between paralysis and spasmodic contracture of this muscle (Torticollis) consists in the circumstance that in the former case the inclination of the head can be temporarily rectified by passive movement, which cannot be done when the muscle is spasmodically contracted.

The clavicular attachment of the trapezius is usually affected in partial paralysis of this muscle. This is shown by defective elevation of the shoulder.

Paralysis of the Serratus Magnus.

Isolated paralysis of this muscle causes sinking of the outer border of the scapula and elevation of its inner border. Besides this characteristic position of the scapula, the patient is unable to raise the arm beyond the horizontal line. This movement carries the scapula backward toward the spinal column. The groove formed by the spinal processes is then filled up by the volume of the muscle.

Paralysis of the Latissimus Dorsi has been observed to result from lifting heavy weights. The characteristic sign of paralysis of this muscle is the wing-shaped appearance of the scapula, which stands out from the thorax.

Paralysis of the Upper Extremities.

Paralysis of the deltoid is most frequently caused by injuries to the shoulder. The patient is unable to raise the arm to the head, and the shoulder appears sunken. Should the infra-spinatus muscle be paralyzed at the same time, then abduction of the arm becomes impossible, which prevents the acts of drawing, writing, etc.

Peripheral paralysis in the distribution of the radial nerve is of frequent occurrence, owing to the liability of this nerve to suffer from injuries and exposure to rheumatic influences. This nerve is particularly prone to be affected by saturnine palsy. It may be said, in general, of paralysis of the radial nerve, from whatever cause, that nearly all of the extensor and abductor muscles of the arm and hand become involved. The wrist drops, the hand loses its grasp, and the fingers cannot be extended nor applied to any purpose. In lead paralysis, however, the supinator longus remains singularly exempt. More or less anæsthesia or paræsthesia is usually associated with the paralysis. Diminution of the electro-muscular contractility is noticed

before long, and, if improvement does not soon follow, it may be entirely lost. Finally contractures and atrophy of the affected muscles indicate degeneration of the nerve.

Paralysis of the upper extremities from central lesions is not attended by anæsthesia nor loss of electro-muscular contractility. It is further distinguished by the history of the case and the concomitant symptoms.

Treatment. In regard to the treatment of paralysis of isolated muscles of a rheumatic nature, and that resulting from slight traumatic causes, the greatest dependence must be placed on electro-therapy, though a systematic course of friction and massage should not be neglected.

Paralysis of the Lower Extremities.

The most common example of isolated paralysis of the muscles of the lower extremities is observed in the disease known as the spinal paralysis of children. Those of a peripheral nature occur from injuries in the distribution of the crural and sciatic nerves, especially during difficult labors and from compression of intra-pelvic tumors. Rheumatic influences and some obscure affection of the nerves following acute diseases also give rise to paralysis of the lower extremities.

When the crural nerve alone is involved there is an arrest of the action of those muscles which raise the trunk from a sitting posture and straighten the knee; but paralysis of the lower extremities happens far more frequently from disease of the sciatic nerve. Any of its principal branches may be exclusively involved, and lead to manifold deformities of the limb.

Treatment. Electro-therapy accomplishes excellent results in cases of recent origin, and even deserves a trial in those of a chronic order that have not yet advanced to complete loss of the electro-muscular contractility.

CHAPTER VI.

SPASMODIC AND ALLIED AFFECTIONS.

Spasms of the Ocular Muscles.

Hardly more than a brief allusion to this subject is necessary in this place, since it is more appropriately considered in works treating on diseases of the eye.

Tonic Spasm of the levator palpebræ superioris rarely occurs in an isolated form. This affection causes fixation of the upper eyelid, so that the eye cannot be voluntarily closed (Lagophthalmos Spastica). Its occurrence depends either upon a peripheral or a central source of irritation.

That form of strabismus which is frequently noticed in conjunction with symptoms denoting cerebral disease is due to a tonic spasm of the external muscles of the eyeball. It is also observed as a transient symptom of a reflex character during dentition, and in the intestinal affections of children.

The involuntary oscillatory movements of the eyeball called *nystagmus* result from clonic spasms of the ocular muscles. In the majority of instances it is a symptom of various affections of the eye; but it may also depend upon intracranial lesions, or be merely a reflex phenomenon due to irritation of remote organs.

The sphincter of the eye is subject to clonic and tonic spasms. In the former instance the iris contracts and dilates in rapid succession (Hippus). This is, in most cases, a symptom of retinal irritability.

Contraction of the pupils due to tonic spasm of the iris indicates peripheral or central excitation of the oculo-motor nerve. It is important to distinguish this form of myosis from that due to paralysis of the oculo-spinal center.

Treatment. The spasmodic affections of the ocular muscles, which have been mentioned, obviously require a causal treatment.

Spasms Occurring in the Course of the Trigeminus. Trismus, or "lock jaw," is a bilateral tonic spasm of the masseter and temporal

muscles, which are both supplied by motor fibres of the trifacial nerve. This formidable symptom is invariably present in tetanus. It is not uncommonly witnessed in violent hysterical fits, and may even persist for a considerable length of time after the subsidence of the paroxysm, as I have observed in several instances. Rheumatic trismus, according to my experience, is unilateral. It is attended by pain, which the patient locates in the jaw, behind the ear and about the neck. This form of trismus is best treated by hypodermic injections of morphia and the application of dry heat.

Spasms Occurring in the Course of the Facial Nerve. The muscles to which the facial nerve is distributed are subject to partial and general spasms. Both kinds of spasms are commonly of a reflex character. Any exciting cause that acts directly upon the trunk of the nerve, its central connection or its peripheral expansion, can give rise to convulsive movements of the facial muscles.

Involuntary closure of the eye from tonic spasm of the orbicularis palpebrarum muscle (Blepharospasm) is nearly always associated with various affections of the eye, particularly with conjunctivitis and ulceration of the cornea. This connection shows the reflex nature of the contraction. Blepharospasm usually affects both eyes. Immoderate winking, which in a milder form is habitual with some people, results from clonic spasms of the eyelids. As a reflex phenomenon it frequently complicates spasms of other facial muscles.

Single muscles and groups of muscles of the face are subject to spasmodic movements under a variety of circumstances. The so-called "tricks" are probably of a congenital or hereditary character. One of the earliest symptoms of general paresis is a quivering of the upper lip. This is also frequently noticed in elderly persons. Violent spasms of the facial muscles occur in intracranial tumors and in chronic syphilitic meningitis.

General clonic spasms of the face (Tic convulsif) cause contortions of the features. The grimaces which are thus involuntarily produced are distressing to witness. The forehead from violent action of the occipito-frontalis muscle is thrown into deep folds. There is compression of the eyelids, rimpling of the nose, twisting of the mouth, twitching of the chin, etc. In cases of a reflex character, usually complicated with neuralgia of the trigeminus, the spasms are readily excited by the acts of mastication, laughing, and even talking.

Spasms of the Sterno-Mastoideus and the Trapezius.

Rheumatic influences affecting the superficial branches of the spinal accessory nerve often give rise to spasms and contractures of the muscles that rotate and bend the head. The ordinary "wry neck" is of this character. Nodding of the head is occasionally noticed in children who suffer from disease of the vertebræ. Tonic spasms of the sterno-cleido-mastoid produce forcible rotation of the head—the chin being directed to the healthy side and the head to the affected side. The belly of the muscle appears to be swollen. This deformity cannot be rectified by passive movements. At a later stage, the symmetrical muscle of the opposite side wastes, which increases the deformity. Tonic spasms and contracture of the trapezius cause a similar deformity; but the head is retracted and inclined to the affected side. The upper portion of the muscle bulges considerably.

Treatment. It is of paramount importance, in view of the reflex character of most of the forms of spasms that have been mentioned, to pay attention to the primary cause. Those cases which complicate neuralgia often yield to the hypodermic injection of morphia. Even as a palliative it is superior to any other remedial measure in instances that admit only of a symptomatic treatment. Galvanism is also worthy of a trial.

Writer's Cramp.

The nervous disorders which interfere with the co-ordination of movements necessary in avocations that require the delicate use of the hand and fingers—as in sewing, writing, drawing, and performing upon musical instruments—may be conveniently grouped under the above affection, which is the most common and best known of the "Artisan's Cramp." The disturbance of the muscular mechanism in writer's cramp is brought about partly by a spasmodic condition, and partly by a certain degree of paresis of the thumb, the index and middle fingers, which are all engaged in the act of writing. There may be either rigid extension of the index finger, which releases the hold on the pen, or the pen is tightly pressed between the thumb and the index finger, as both become affected by the tonic spasm. Sometimes the thumb or the middle finger becomes firmly flexed on the palm, which renders the grasp of the pen impossible. Should the person still be enabled to retain the pen in its proper position, he contrives to write by firmly pressing the forearm against the desk; but the arm soon tires and

begins to tremble, pain is felt along its whole extent, and not seldom the limb is seized by clonic spasms. In some persons the affection commences with tremors and weakness of the arm and fingers, which not only renders the act of writing irksome, but often causes the pen to drop from the hand. It is remarkable that the gross motor power of the limb remains normal, and that any manner of work, except writing, which requires nicety in the use of the hand and fingers, can be performed without difficulty. So soon as the pen is laid down there is a cessation of the cramp.

The Etiology of writer's cramp is quite obscure. The inordinate use of the pen appears to act as the exciting cause in individuals in whom there exists a neuropathic element. There can hardly be anything particularly hurtful in the use of the steel pen, which is now in common use, for writer's cramp was observed when only quills were used.

Nothing positive is known concerning the pathology of this nervous affection. Morbid anatomy is silent regarding its distinctive anatomical changes.

The Diagnosis of writer's cramp offers no difficulties. It is only carelessness that would confound it with senile trembling of the hand, with immobility of the fingers from chronic rheumatism, or with the ataxic condition of these parts in tabes dorsalis.

The Prognosis of writer's cramp is not favorable—a permanent cure being the rare exception. The disorder progresses from bad to worse if treatment does not effect some improvement.

Treatment. Writing must be strictly prohibited, whatever mode of treatment be adopted. The many contrivances that have been invented for steadying the fingers in holding the pen exercise no curative effect. Learning to write with the sound hand is of little avail, for it is liable to become affected like the other. Friction of the parts with stimulant or sedative liniments is useless; massage, however, is not seldom of temporary benefit. Strychnia has proved itself harmful even in cases of a marked paretic nature. Duchenne does not speak encouragingly of the interrupted current in this affection, but galvanisation is indubitably of benefit. Temporary amendment of the spasm and tremor not only follows the use of this form of electricity, but even permanent cures have been effected by it. The mode of application must vary with the localization of the cramp and tremor. It is best to apply the anode to the affected muscles and nerve trunk, and the kathode to the spine. From 15 to

30 elements may be used. Each sitting should last about 10 minutes, and be repeated every other day. Tenotomy has been successfully practiced in a few cases.

Paralysis Agitans ("Shaking Palsy").

Tremor constitutes the essential symptom of this affection. A muscular weakness, which seldom advances to complete paralysis, soon becomes superadded, and frequently the violent action of some of the antagonistic muscles causes sudden jerking of the head and limbs. The abnormal movements, as a rule, begin in the hand and arm of one side, and then gradually become general. In some cases they are confined to one side of the body, or only to one extremity. At first the patient is able to control the shaking to some extent by a strong voluntary effort, or by leaning against a support. Mental commotions or unusual physical exertions aggravate the shaking. The tremor interferes with speech and the act of deglutition, and also causes disturbance of many other motor functions, but ceases during sleep. The paralysis which develops subsequent to the appearance of the tremors is most apparent in the extensors of the forearm. This, in connection with tonic contraction of the antagonistic muscles, occasions deformity of the fingers. At a later period, when the paralysis increases, there is unsteadiness of gait, the head leans forward and the body is often seized with propulsive movements. Complications of sensory disturbances, such as tingling, formication and incomplete anæsthesia, are less frequently observed than the cephalic symptoms,—headache, vertigo, insomnia, etc. The approach of the fatal termination is indicated by the continuance of the tremor during sleep, and general disturbance of the vital functions. Many patients are carried off by intercurrent diseases.

Etiology. Paralysis agitans is an affection of advanced life. From this it has been inferred that senile decay acts as a predisposing cause. The disease is mostly observed to occur in persons who have experienced a great deal of hardship in life.

Our knowledge of the pathology of this disease is as meagre as that of its causation. The few post-mortem examinations that have been reported gave negative results as regards any uniform lesion of the nervous system, though various anatomical changes were noticed in different parts of the brain and spinal cord.

The Differential Diagnosis must distinguish paralysis agitans from the following affections: Senile, mercurial and saturnine tremor; the tremor of alcoholism and of multiple sclerosis. The movements of senile tremor are less violent than those of shaking palsy, and they are not attended by semi-paresis and deformity of the extremities. Mercurial and saturnine tremor can be easily recognized by the symptoms which are peculiar to the morbid action of each of these metals upon the human system. Alcoholic tremor is attended by a peculiar form of delirium. The tremor of sclerosis is evoked only when the patient attempts to carry out some voluntary movement. A tremor greatly resembling that of paralysis agitans has been noticed in young persons after a mental shock, such as a sudden fright or terror.

The Prognosis of paralysis agitans is bad; improvement, even in recent cases, being rarely observed.

Treatment. It would be unprofitable to enumerate all the remedies that have been tried in this disease without any satisfactory results. The prolonged use of the subcarbonate of iron appeared to have been successful in a case reported by Elliotson. Charcot's case derived some benefit from hyoscyamine. Reynolds observed good results from the wearing of a "Pulvermacher's chain." Galvanism seems to palliate the tremor. Hypodermic injection of morphia is followed by temporary mitigation of this symptom. I have seen no improvement from large doses of chloral hydrate and the bromides.

CHAPTER VII.

DISEASES OF THE MEMBRANES OF THE SPINAL CORD.

Hyperæmia of the Meninges.

A congested condition of the spinal membranes, due to the position of the corpse, which favors the gravitation of the blood towards the vertebral column, is a very common post-mortem appearance. Fullness of the meningeal bloodvessels in persons who have died from convulsions or asphyxia is equally devoid of pathological significance. But spinal symptoms in stasis of the venous circulation, as in portal obstruction, suppression of the menses, etc., suggest the existence of hyperæmia of the meninges. Experience has taught that these symptoms are best treated by antiphlogistic measures. The pain in the back, the morbid sensibility and the feeling of numbness and formication in the lower extremities, are found to yield readily to wet cups and cold douches to the sacrum, and the administration of saline cathartics.

Hemorrhage of the Meninges.

Injuries to the spinal column are liable to give rise to extravasation of blood in the venous plexuses, between the vertebræ and the dura mater. The symptoms of "spinal apoplexy" develop suddenly and with great violence. The pain in the back is intense; the patient falls over as if shot, his lower extremities become powerless, and the nervous prostration is extreme. After a variable time, not exceeding, however, twenty-four hours, the effects of the shock pass off and give place to a group of symptoms characteristic of spinal meningitis.

Spinal Meningitis.

Suppurative inflammation of the pia mater of the cord is frequently associated with a similar affection of the cerebral membranes. The simple or sporadic form of spinal meningitis is a rare disease. Its

etiology is obscure; but probably exposure to cold and dampness, acting directly upon the spine, constitutes the exciting cause.

Anatomical Changes. The tissue of the pia mater is filled with an inflammatory infiltration that extends to the meshes of the arachnoid. The membrane is injected, thickened and dense, particularly on the posterior aspect of the cord. Fibrinous deposits are gathered on the inner surface of the dura mater, and a serous or purulent exudation (the latter of a yellowish-green color) is sometimes spread over the whole length of the cord. In some cases there is an entire absence of the exudation, so that the pia mater only shows deep vascularization.

Clinical History. In many cases the symptoms of spinal meningitis are mixed up with "head symptoms," resulting from the simultaneous implication of the cerebral meninges. Under these circumstances the spinal affection is only of secondary importance. An analogous combination of symptoms is presented in myelo-meningitis; but here, again, the meningeal symptoms play but a subordinate part. Simple acute inflammation of the membranes of the cord exhibits marked characters. The most prominent is pain along the spine and in the extremities. This is attended by stiffness of the muscles of the trunk and limbs. The least movement of the body brings on fits of pain and muscular rigidity, and, for this reason, the patient lies perfectly quiet, and represses even the acts of coughing and sneezing. This voluntary immobility presents the appearance of loss of muscular power, but paralysis is not a symptom proper to spinal meningitis. The muscular stiffness bears great resemblance to tetanic contractions. In explanation of this symptom it has been suggested that the rigidity is probably due to the instinctive effort of the patient to prevent the pain by keeping his body and extremities at rest; and, in fact, it is noticed that he is free from the pain and rigidity so long as he avoids movements. Some degree of hyperæsthesia is always present, and also an increase of reflex excitability. Loss of power over the bladder, preceded by frequent desire to pass urine, is also a very marked symptom. The bowels are confined, and fever, if present at all, is moderate.

Diagnosis. The clinical peculiarities of acute spinal meningitis are not easily mistaken for spinal hyperæmia or tetanus. The chief features of the latter disease (the trismus and the spasmodic paroxysms, which recur whether the patient be moving or at rest) offer sufficient points of differential diagnosis.

Prognosis. When "head symptoms" make their appearance, or when the meningeal inflammation has resulted from a traumatic cause, prognosis is unfavorable. Cases in young persons, due to rheumatic influences, not infrequently recover.

Treatment. The local abstraction of blood, the application of the ice-bag to the spine, and iodide of potassium internally, constitute the approved remedies in acute spinal meningitis. The pain must be subdued by injections of morphia. Such an active treatment is, however, out of place if the disease becomes chronic. In the latter event, attention is rather directed to the associated symptoms of myelitis.

Epidemic Cerebro-Spinal Meningitis.

A virulent type of this disease proved very fatal in the camps and barracks of the Northern and Southern armies during the late civil war. Epidemics of a limited extent have since then appeared in different parts of the country. In 1871 an epidemic of brief duration visited this city, which mostly attacked children. The name of "spotted fever" is given to this disease in many localities, on account of various skin eruptions that make their appearance during its course.

Anatomical Changes. The pathological changes found after death show decided evidences of meningeal inflammation within the cranium and spinal canal. A more or less abundant exudation of lymph and pus collects beneath the arachnoid. When limited in quantity it is most copious at the base of the brain. Different parts of the cord or its whole length may be covered by the purulent deposit. The ventricles are sometimes filled with a turbid fluid. Occasionally the substance of the brain and of the spinal cord exhibits minute spots of softening. It is remarkable that the most virulent type of the disease does not always show decided evidences of an inflammatory process.

Clinical History. The premonitory symptoms are of an ill-defined character. For a few days preceding the invasion, patients complain of headache, lassitude, nausea, and perhaps repeated shivering. A decided chill is not common. In an epidemic reported by Dr. Githens, which he witnessed in Philadelphia, in 1867, the prodromic stage averaged eight days.

The full development of the disease is characterized by the accession of fever, intense headache, pain in the spine and rigidity of the muscles of the neck. During the course of the disease a number of other symptoms are observed which mainly depend upon the meningeal inflammation. The febrile movements present nothing peculiar. At the commencement the fever is usually of a high grade and shows irregular remissions and exacerbations.

Cephalalgia is one of the most constant symptoms. The pain is sometimes of such extreme violence that patients become almost frantic from its persistence.

The rhachialgia is most intense in the sacral region. The least movement of the body, as in rising and turning in bed, starts and aggravates the pain. Darting and lancinating pains also affect the lower extremities. Very young children evince their fear of the pain on being disturbed, by screaming whenever they are about to be lifted from the bed, or are made to change their position in feeding and in dressing. A very conspicuous symptom of the disease is rigidity of the muscles of the neck, frequently combined with retraction of the head. Even in those instances where this symptom seems to be absent, it will be found that the patient is unable to approach the chest with his chin. The exalted sensibility of the skin and muscles is especially well marked in the lower extremities. Sometimes the heightened reflex excitability is of such an acute character that the slightest touch of the body, or even footsteps in the sick-room, cause the patient to start up and to shudder. Probably the rigidity of the spinal column, amounting sometimes to opisthotonos, results from reflex action superinduced by hyperæsthesia. Trismus is but rarely observed.

Vomiting is an exceedingly troublesome symptom, but usually it stops soon after the onset, though it is liable to return during the course of the disease.

Among the less constant symptoms may be mentioned delirium, somnolence and stupor. The initial stage in children is frequently attended by general convulsions. Cramps of the muscles of the back, thighs and legs are not uncommon.

Disturbances of the special senses constitute the most serious complications of the disease. During its height there is considerable deafness, and this may unfortunately lead to total loss of hearing. In children of tender age it usually leads to deaf-mutism. The eyes become affected in various ways. Ulceration of the cornea

belongs to the earlier stage. Inequality of the pupils comes on later. Great dilatation of both pupils is a grave symptom. Amaurosis is principally due to a descending neuritis which eventually terminates in atrophy of the optic disk.

The urinary functions are seldom disturbed. Children are occasionally troubled with repeated and painful micturition.

Cutaneous eruptions constitute a marked feature in many of the epidemics. Clusters of herpetic vesicles appear on the lips, nose and cheeks. Roseolar spots and copious crops of urticaria are sometimes noticeable at an early date. Petechiæ are less common.

Course and Duration. The preceding analysis of the symptoms, in place of a consecutive description of the phenomena that mark the clinical history of cerebro-spinal meningitis, is rendered necessary by reason of the irregular and variable course of this disease. During the prevalence of an epidemic, cases come under notice which differ in many respects from the ordinary type. What has been designated as the "explosive" or "fulminant" variety is a most terrible affection. Persons appear to be stricken down at once by the intensity of the morbid cause. The sudden collapse of such patients, from which they seldom recover, is probably due to paralysis of important nerve centers. On the other hand, very mild or so-called abortive cases are occasionally observed which would hardly be recognized, were it not for their occurrence at the time of an epidemic.

The sporadic form of cerebro-spinal meningitis is of a very rare occurrence. It differs in no essential particulars from the epidemic variety.

Unfavorable cases, as a rule, run a rapid course. The greater proportion do not survive the fifth day. In malignant cases, death may ensue in less than thirty-six hours. The average duration is about sixteen days. A fatal termination in protracted cases is to be feared from the effects of extreme emaciation. The rate of mortality ranges from 30 to 75 per cent.

Etiology. Epidemic cerebro-spinal meningitis must be classed with the acute infectious diseases. This is evident from its simultaneous occurrence in a number of individuals who inhabit the same town or district. The characteristic symptoms of the disease, however, are mainly due to the meningeal inflammation. The conditions which favor the development of an epidemic are overcrowding in camps, jails, barracks, etc. More males are attacked than females.

Diagnosis. The prominence of cerebral and spinal symptoms, when observed in connection with a high grade of fever which attacks a number of persons at the same time, renders diagnosis comparatively easy. Exceptional severity of the "head symptoms" in typhoid fever, and in the pneumonia of infants, may, for a while, cause embarrassment.

Prognosis. Epidemic cerebro-spinal meningitis is a dangerous disease. Recovery from the fulminant variety can hardly be expected. A cautious opinion, even in the mildest form of the disease, is advisable. General convulsions, incessant vomiting and the comatose condition are unfavorable signs.

Treatment. The rational employment of the so-called antiphlogistic measures is still in favor with many experienced physicians, probably from the conviction that in acute meningeal inflammation the resources of our art can hardly offer anything better. Very little, if anything, can be done in those virulent cases that speedily tend to a fatal termination. Venesection is only indicated in intense cerebral congestion. Local abstraction of blood affords relief to the headache. Layers of leeches, according to the urgency of the symptoms, should be repeatedly applied to the temples and behind the ears. Cups are better adapted for the spine. At a later period, some good effects may be expected from blistering the nape of the neck. Cold, by means of the ice-helmet, should be unremittingly applied to the head so long as the patient will tolerate its use.

Opinions differ in regard to the efficacy of mercury in this disease. My experience induces me to place much confidence in this remedy. I have seen good results from frequently repeated doses of calomel, until the gums become slightly affected.

Active purgation may be of service in the beginning, but must not be kept up.

Quinia appears to have no controlling influence in this disease. Its antipyretic properties, however, may be of service when the temperature is excessive.

Opium and its preparations are of decided benefit, not only in allaying the pain in the head and promoting sleep, but also in exerting a favorable influence on the course of the disease. Prof. Stille, who is a great advocate of the opium treatment, recommends one grain of the narcotic every two hours, and, in severe cases, the same dose every hour.

CHAPTER VIII.

DISEASES OF THE SPINAL CORD.

Myelitis.

The inflammatory process in myelitis involves the substance of the cord to the exclusion of the meninges. Either the parenchymatous or the interstitial tissue may be primarily affected. According as the pathological changes vary in extent and situation they are of a diffused, circumscribed or disseminated character. Myelitis occurs as an acute and chronic affection. In regard to its etiological factors, the disease is divided into primary and secondary myelitis.

Acute Myelitis.

Anatomical Changes. The inflamed portion of the cord is changed in color and consistence, corresponding to different grades of softening, which sometimes amount to complete breaking down of the tissue. In some instances the affected parts appear thickened or shrunken and atrophied. The different shades of color presented by the softened parts depend upon the variable quantity of blood with which they are mixed. In the majority of cases the softening is most intense in the central grey matter. The morbid alterations are usually well marked in the dorso-lumbar region.

The microscopical appearances in the softened tissue consist of compound granule corpuscles, fat globules, pigment cells, free nuclei and degenerated nerve fibres and cells. In the early stage, before softening has taken place, the following anatomical changes are observed. The bloodvessels are dilated and sometimes covered by a granular exudation. Considerable alterations are noticed in the nervous elements. The nerve fibres appear thickened, and the axis cylinders show varicose swelling. The nerve cells are enlarged and rounded, or shrivelled and wasted; but the greatest pathological interest attaches to the presence of the nucleated granule cells (so-called exudation cells), which are derived from the neuroglia, and

indicate the implication of this tissue in the inflammatory process. They are found in all forms and stages of myelitis.

The diffuse form of myelitis is characterized by the spread of the disease in the ascending and descending direction. In cases of this kind, the sciatic nerve and the muscles to which it is distributed are found in a state of fatty degeneration.

Clinical History. The symptomatology of acute primary myelitis agrees in all essential points with that of traumatic myelitis, which is by far the more common form of the disease. It is understood that the term acute, when applied to myelitis, expresses the sudden development of the symptoms, irrespective of their longer or shorter duration.

An attack of primary acute myelitis is usually ushered in by a sensation of tingling or numbness of the parts that eventually become paralyzed. Sometimes there is merely a feeling of tiredness and stiffness in the limbs. Shooting pains and cramps in the muscles are not uncommon. Other cases begin with a disagreeable sensation of weight and pressure in the back, bladder and rectum, or there is only an uncontrollable restlessness.

Paraplegia is typical of the full development of acute myelitis. In the vast majority of cases the lower extremities are alone affected, owing to the most frequent implication of the inferior portion of the cord. The upper extremities are also paralyzed when the cervical region of the cord is the seat of the disease. Hemiplegia of spinal origin is of exceptional occurrence. In severe cases the paralysis of motion and sensation is complete. The patient has lost all power of movement in the extremities. There are, however, different grades of paralysis, proportionate to the extent and intensity of the pathological changes. Frequently the ability to raise the limbs to a slight extent is still retained, and, in cases of moderate severity, the patient can move them freely about in bed. Should he be able to walk with or without the assistance of crutches, it is noticed that his limbs tremble and the feet "drag."

Paraplegic anæsthesia of the same distribution as the motor paralysis is nearly constant in acute myelitis. Complete loss of the cutaneous sensibility is the rule. In some cases the patient complains of spontaneous pains in the limbs, causing reflex spasms of the muscles. A rather common symptom is a feeling of constriction about the waist as if a belt were drawn tightly around it.

The reflex excitability of the cord is usually diminished when the lumbar segment is involved; it is sometimes increased when the upper dorsal or cervical portion is alone affected. Its complete obliteration at the onset of the disease, or its gradual loss in protracted cases, gives a bad prognosis.

The electro-muscular contractility of the paralyzed muscles remains normal for a considerable length of time. Toward the close of the disease it diminishes until it is completely abolished.

Atrophy of the affected muscles is only noticed in very severe cases. As a rule they retain their volume to a late stage of the disease. The sphincters at the commencement show signs of irritability, the evacuation of the bladder being attended by a straining effort, and there is frequent retention of urine. At a later period, incontinence takes place, which eventually leads to cystitis. Obstinate constipation of the bowels or tenesmus, and finally involuntary discharge of the feces, result from simultaneous paralysis of the sphincter of the rectum. In men the virile power becomes feeble or is entirely lost.

Bed sores are common in all forms of myelitis. They often develop from vesicles which appear on parts of the skin which are not subject to pressure. This evidently shows that the decubitus is due to trophic disturbance. The œdematous swelling of the extremities must be ascribed to the same cause.

The temperature of the affected limbs is lowered, but cases are on record in which it was much increased at the beginning of the disease.

The brain remains unaffected, except in cases where the degenerative changes invade the upper portion of the spinal cord. If cerebral symptoms develop in ordinary acute myelitis, they probably result from pyæmic infection or uræmic poisoning.

The course of acute myelitis varies with the seat, extent and progressive tendency of the morbid process. Its most frequent termination is either complete or incomplete paralysis. This may remain stationary, or eventually prove fatal from the extension of the disease in an upward direction, or from serious complications. Paresis of the upper extremities, embarrassment of respiration, difficulty of deglutition, and pupillary changes indicate the spread of the destructive changes to the cervical region and beyond it.

Etiology. Idiopathic acute myelitis is usually attributed to the combined effects of cold and dampness to which the spine is exposed,

to violent physical efforts, or excessive sexual indulgence. Cases have been known to follow some strong emotional disturbance, especially terror (Emotional paralysis). Traumatic myelitis and that form known as the "railway spine," agree in the main with the clinical history of acute myelitis. The myelitis from compression develops when caries of the vertebræ or intra-spinal tumors suddenly set up structural changes in the cord of an inflammatory character.

Diagnosis. The differential diagnosis between primary and secondary acute myelitis is not always easy. Fracture of the vertebræ may not be recognizable; and the existence of an intra-spinal tumor can at best be only surmised. It is well to remember that the rapid development of complete paraplegia, usually attended by the symptoms of shock, is significant of hemorrhage in the cord, whether of spontaneous occurrence or following a traumatism or coming from a tumor within the spinal canal. The diagnosis of acute myelitis is obscured by its frequent complication with spinal meningitis, though it is not difficult to assign the symptoms proper to each of these affections.

Prognosis. The prognosis of acute myelitis can be inferred from what has already been stated. This may be summarized as follows:

The prognosis is favorable when the paralysis is incomplete or partial; when the sphincters are little or not at all affected; when the reflex excitability of the cord and the electric reaction of the muscles remain normal; when the paralysis rapidly improves and bed sores take on the healing process.

It is unfavorable when the upper portions of the cord are involved; when the paralysis is complete and does not improve, and when the sphincters are much enfeebled. The early appearance of bed sores, but more especially the development of cystitis, forbode danger to the patient.

Treatment. In recent cases of traumatic myelitis, local abstraction of blood, followed by the application of the ice-bag near the seat of injury, may be tried with the intention of subduing the inflammation. This active treatment should not be continued too long. Brown-Sequard recommends in its place the administration of ergot and belladonna. The older surgeons were much in favor of the bichloride of mercury in traumatic myelitis. Iodide of potassium is, however, a safer remedy. Blistering is advisable at a later period. Dr. Radcliffe expects better results from the tincture of chloride of iron, which he thinks has a tendency to counteract the low inflammatory

process characteristic of acute myelitis. There is a general agreement, however, to trust more to the curative influence of rest than to any special medication. The patient should be strictly forbidden to leave his bed for the first three months. For the same reason the ill-advice of officious friends that he be encouraged to take active exercise, must be opposed. Resting upon the side is preferable to the recumbent position.

Attention to the functions of the bladder is urgently required throughout the whole course of the disease. In retention of urine, nothing can replace the prompt use of the catheter. Bed sores are sometimes prevented or at least stayed for a considerable time, by properly adjusting the bed-clothes so as to avoid the formation of folds and wrinkles. A general supporting and tonic treatment should be early begun. The patient should be allowed a nutritious diet, and take quinia, iron and cod-liver oil. The iodide of potassium may be given alternately with these tonics. At a later period a trial may be made with strychnia; but this remedy must at once be abandoned when it lights up inordinate reflex excitability. The same rule must be observed when electricity is employed. Mild cases are sometimes benefited at the onset by the constant current; but generally it is advisable not to be too hasty with this therapeutic agent. Patients derive great comfort from gentle friction of their paralyzed limbs, and this is all the good that the reputed liniments can accomplish. The stimulative effect of warm baths proves injurious when incautiously ordered at an early date of the disease. There is, however, no doubt that many paraplegic invalids have derived benefit from the use of the Hot Springs of Arkansas and the Hot Sulphur Baths of Virginia. It is well to excite the nutrition of the paralyzed muscles by kneading and the application of faradism.

Chronic Myelitis.

This heading includes a large class of spinal affections, some of which undoubtedly depend upon a slow and insidious inflammation of the cord, whilst the pathology of others is still undetermined. Paraplegia, more or less complete, is a symptom common to all of them.

The Anatomical Changes in cases of primary chronic myelitis embrace disintegration of the nerve elements and nerve roots, proliferation of the neuroglia and thickening of the coats of the

bloodvessels. A fine vascular network replaces the grey substance. Transverse sections of portions of the cord present the appearance of a finely granular substance, which Lockhard Clarke describes as "grey degeneration" of the cord. In some cases the cord becomes indurated, which causes destruction of the nerve tissue.

Clinical History. A noteworthy fact in the early history of chronic myelitis is the apparently insignificant character of the symptoms, that gradually give way to the development of the more reliable signs which mark the disease. At first there may be merely vague, wandering pains and a sensation of numbness, tingling or creeping in the lower extremities. The pains, which occasionally become aggravated and often affect also the back and loins, are likely to be mistaken for rheumatism. Many patients experience an unaccountable sensation of fatigue while standing or walking; they take frequent rests and seek support when on their feet, which "drag" as they move along. Frequently there is a feeling as if the legs were "asleep," and a sensation of constriction about the waist. A greater length of time is occupied in urinating than formerly, and there may be "dribbling." Impairment of the sexual function is evidenced by imperfect erections and premature ejaculations.

As the disease advances in the transverse direction of the cord, more or less of the central grey matter becomes involved. The motor and sensory disturbances hold even pace with the depth and the extension of the destructive changes. The paraplegia, the implication of the sphincters, the enfeeblement or loss of the sexual function, and all the adventitious phenomena which were described as constituting the symptomatology of acute myelitis, are reproduced in the chronic form of the disease.

Etiology. With the one exception of violent injury, every cause that was enumerated in connection with acute myelitis favors the development of chronic parenchymatous inflammation of the cord. It mainly depends upon the sudden or slow action of the exciting cause whether one or the other shall develop. Some of the paraplegias of an uncertain pathology require a brief consideration.

Hysterical Paraplegia.

Briquet met with 18 cases of paraplegia in 113 hysterical patients who suffered from different forms of paralysis. The presumptive evidence of the hysterical character of the paralysis rests upon its

conjunction with other symptoms of a decided hysterical nature. But hysterical paralysis presents some peculiar features which greatly assist the diagnosis. As a rule the paralysis is incomplete, and associated with anæsthesia of a marked kind. The muscles have lost their electro-sensibility, while their electro-muscular contractility remains intact. The sphincters suffer less than in ordinary transverse myelitis, but owing to an abnormal sensibility the bladder is irritable, and retention of urine, probably due to reflex action, is liable to occur.

Syphilitic Paraplegia.

Paraplegia of a syphilitic nature may be suspected when signs of the constitutional disease are present, and no other palpable cause of the paralysis can be assigned. The result of antisyphilitic treatment is, however, of the greatest diagnostic importance. But even this is not conclusive, for an ordinary myelitis sometimes yields to potassium iodide.

Paraplegia after Acute Diseases.

Paraplegia, as well as other forms of paralysis, is now and then observed to occur during the convalescence of acute infectious diseases. Spinal paralysis has been known to follow diphtheria, smallpox, scarlatina, measles, erysipelas and typhoid fever. It is hardly to be supposed that an actual lesion of the cord underlies these forms of paralysis, as they show a tendency to disappear spontaneously.

Reflex Paralysis.

By this term is understood a paralytic affection which is due to the influence of an irritation existing in a remote part—usually the urinary, uterine or intestinal apparatus. Although many of these supposed examples of reflex paralysis frequently turn out to result from actual lesion of the cord, there are others in which such a relation cannot be shown to exist. Brown-Sequard's theory of reflex paralysis assumes an anæmic condition of the cord, induced by reflex action of the distant source of irritation that causes constriction of the spinal bloodvessels. Leyden refers the paralysis to an ascending or migrating neuritis.

The treatment must be directed to the removal of the ascertained exciting cause; but the paralysis sometimes persists in spite of the disappearance of the primary affection.

Treatment of Chronic Myelitis. To avoid unnecessary repetitions, it may be broadly stated that the indications of treatment in chronic myelitis and its allied affections are the same as in acute myelitis; but, with these exceptions, the local abstraction of blood may be omitted; a course of electric treatment should be begun at once, and the patient be allowed to take gentle exercise.

Acute Ascending Paralysis (Landry's Paralysis).

This is a rare form of spinal paralysis. Its etiology is obscure, though the disease has been known to succeed smallpox, diphtheria and pneumonia. The paralysis extends in an upward direction, affecting first the lower and then the upper extremities. When the disease involves the medulla oblongata it speedily proves fatal. There is no anæsthesia, and the electric excitability remains normal. Post-mortem examinations have thus far discovered no lesions in the cord to account for the paralysis. Disturbances of respiration and deglutition are of the gravest import. The disease suggests the treatment of acute myelitis.

Anterior Acute Polyomyletis (Infantile Spinal Paralysis).

This disease was described by the older writers under the name of "the essential paralysis of children." In the greater number of cases the onset is sudden and marked by a high grade of fever. Paralysis of the lower extremities rapidly develops. There is no loss of sensibility, nor implication of the sphincters. Improvement of the paralysis is soon established, but certain isolated muscles or groups of muscles seldom regain their normal motility. They finally waste, and, in consequence, deformity of the affected limb takes place.

Anatomical Changes. The meagre accounts concerning the anatomical changes at an early period of the disease relate to evidences of a diffuse inflammation almost exclusively confined to the anterior grey horns of the lumbar or cervical enlargement of the cord. At a later stage these parts are found wasted and shrunken. The antero-lateral columns present similar pathological alterations; but the most important structural change in the anterior grey horns is the disappearance of many of the multipolar ganglionic cells. The

corresponding anterior roots of spinal nerves exhibit signs of secondary degeneration.

Clinical History. Acute symptoms of very short duration (fever, delirium, and, in small children, general convulsions) usher in the paralysis in the greater number of cases. Sometimes there is an entire absence of the acute stage. The child on waking up in the morning is found to be paralyzed, or the loss of motility is gradually established. Very soon the paralysis becomes limited to one of the upper or, far more frequently, to one of the lower extremities. It is not unusual for the circumscribed paralysis to affect only certain groups of muscles. The muscles supplied by the peroneal nerve appear to be the favorite seat of the paralysis. Whatever may be the extent or severity of the paralysis, considerable improvement takes place after the lapse of a few weeks, and sometimes speedily terminates in recovery. But complete restoration can hardly be expected if the paralysis remains stationary for months. By this time the affected muscles begin to show evidences of atrophy. The muscular wasting appears to come on independently of the paralysis, for the nutrition of the bones also suffers; their growth is arrested, and finally the stunted, withered limb may be reduced to a useless appendage of the body. Various deformities result from the want of antagonism in the paralyzed limbs—"club-foot," "knock-knee," "high shoulder," etc. A peculiar relaxed condition of the ligaments of the joints, favored by the lack of muscular support, interferes much with locomotion.

The paralyzed muscles show diminished reaction to both currents; but the faradic contractility is found abolished in the muscles which are much affected, while the galvanic contractility has not entirely disappeared.

Etiology. Infantile spinal paralysis usually occurs between the ages of one and four years. Nothing definite is known respecting the influences that predispose to the development of the disease. Children in previous good health are as likely to be affected as those of a delicate constitution. It is doubtful whether the period of dentition acts as a predisposing cause. I have seen one instance in which "catching cold" brought on the paralysis. The case was that of a weakly boy of about three years of age, who was made to undergo the "hardening process" of sitting on the cold wet grass immediately after a warm bath.

Diagnosis. Signs of a retarded development in small children occasionally come under notice which may be confounded with some of the phenomena characteristic of infantile spinal paralysis. These little patients are slow in learning to walk, and a helplessness and awkwardness in their movements persist for a considerable period during their growth. There is, however, no fever, no actual paralysis nor muscular atrophy.

The paralysis attending acute cerebral affections in children apparently assumes, in some cases, the spinal type. To make the distinction, it needs only to be remembered that the violent "head symptoms," the pupillary changes, the vomiting, the stupor and coma, constitute a group of morbid phenomena which is not encountered in the spinal paralysis of children.

Progressive muscular atrophy is distinguished by the following diagnostic points: This disease begins in a slow, chronic manner; there is no febrile excitement; the wasting affects symmetrical muscles, and the incomplete paralysis develops gradually.

The temporary paralysis of children, described by Kennedy, results from exposure, or compression of the limbs. That this affection is of a purely myopathic character is shown by the integrity of the nutrition of the muscles and the normal electrical excitability. The paralysis disappears in the course of a few weeks.

Prognosis. Spontaneous improvement of the paralysis up to a certain point may be confidently expected in nearly every case. But this favorable tendency to recovery appears to depend upon the restoration of parts of the cord which were but slightly affected by the lesion. The probability of further improvement must be judged by the condition of the muscles and their behavior to the electric current.

Treatment. Galvanisation holds out the best prospect of success. The application should begin at the close of the second or third week. At first a current of moderate strength should be passed from the spine to the nerves and muscles, and at a later stage a current of increased intensity may be used. Local faradisation, assisted by massage and friction, helps to stimulate the paralyzed muscles. In many cases it will be found necessary to apply an orthopedic apparatus to facilitate walking.

CHAPTER IX.

SYSTEMIC DISEASES OF THE SPINAL CORD.

The diseases of the spinal cord which will be considered under the above head differ in many particulars from ordinary myelitis. Unlike the latter, in which the transverse section of the cord is more or less involved, they are distinguished by anatomical changes which are limited to definite portions of this organ. The uncertainty of the nature of the pathological processes that underlie the morbid alterations of this class of spinal affections, is evidenced by the uncompromising terms, sclerosis and degeneration, that are employed to designate them.

Progressive Loco-Motor Ataxy (Tabes Dorsalis).

This is a chronic disease affecting the posterior columns of the spinal cord, and is clinically characterized by incoordination of movements, while the gross muscular power remains intact.

Anatomical Changes. Transverse sections of the cord present a grey gelatinous mass, which occupies the space between the posterior horns. The cut surfaces appear wasted and sunken. The posterior horns are frequently involved in the same grey degeneration. This morbid change is usually most pronounced in the lumbar division of the cord.

Microscopic examination shows that the affected parts of the posterior columns are changed into a network of fine and dense filamentous tissue from which the nerve-fibres have more or less disappeared. In the most degenerated portions only a few of these fibres are visible, which merely consist of atrophied axis cylinders. In some places the fibres of the neuroglia are of a firm consistence and present a wavy appearance. This apparently new formed tissue contains an abundance of round or oval nuclei and corpora amylacea, also a few stellated bodies, and only occasionally compound granule cells. The coats of the large arteries are thickened and interspersed with pigment cells and granular fat. The grey substance near the

entrance of the posterior roots nearly always participates in the degeneration. Clarke's columns appear atrophied, but the cellular elements remain intact. Atrophy of the optic nerve is sometimes observed, and in rare instances there is a slight shrinking of some of the nerve trunks.

Etiology. Loco-motor ataxy has, in some cases, been traced to the immediate effects of exposure to cold and dampness. It is highly probable that venereal excesses occasionally develop the disease. Syphilis has also been blamed, and probably with good reason. Men in the middle period of life are especially liable to be affected.

Clinical History. It is convenient to divide the clinical history of loco-motor ataxy into three stages, although the wide range of the functional disturbances and the irregularity of their appearance hardly justify such an arrangement.

The Neuralgic Stage. The disease usually begins with pains of a shooting, darting or "lightning" character, sometimes occurring in paroxysms or continuing for days and weeks. In the majority of cases the pains are confined to the lower extremities; but the head, the trunk, the upper extremities or the back may be alone affected. A sensation of numbness or formication is frequently felt in the painful parts. Weakness of the limbs and an unsteady gait become associated with the pains. Patients are apt to ascribe all these symptoms to their "rheumatism." A careful examination, however, will discover the presence of additional phenomena even at this early stage. Very commonly the genito-urinary functions are in an irritable condition. There is a distressing sensation of constriction around the trunk and limbs as if they were tightened by a band; some degree of anæsthesia particularly evident in the fingers; dimness of vision of one or both eyes and a paretic condition of some of the ocular muscles. The disturbances of vision often disappear. These ill-defined symptoms extend, perhaps, over a number of years, and are usually misunderstood, until others of a more marked character reveal their true nature.

The Ataxic Stage. At this stage the peculiar incoordination of movements signalizes the complete establishment of the disease. All the movements showing this motor disturbance partake of an unsteady, vacillating and impulsive character. Even in the lighter forms some uncertainty in the step or irregularity of locomotion is observed. In noticing the position of the legs it will be seen that

they are held too wide apart; the knees are but little flexed; the limbs are hurled forward or sideways, and the feet, which are raised too high, come down in a stamping fashion. There is evidently an insecure, disorderly adjustment of associated muscular movements; they are excessive and badly controlled. The body reels and is in momentary danger of losing its equilibrium. If the patient attempts to run he will find it difficult to come to a stop. On making a short turn he is apt to trip. He carefully watches his movements and constantly directs his eyes to every step he takes. Before very long he requires the assistance of a cane, and eventually crutches become indispensable.

The final, or paralytic, stage is reached when the muscles refuse to contract in the effort of the patient to assume the erect position. Bed-sores make their appearance, emaciation increases, the muscles atrophy and the sphincters become enfeebled. The cerebral functions remain unaffected to the end.

Analysis of the Symptoms.

The Ataxic Disturbance. An interesting point in connection with this most significant symptom of the disease is the remarkable influence exerted by the sense of sight. When the patient closes his eyes in the acts of standing and walking, his body begins to totter and oscillate as if he were unable to sustain his center of gravity; and if the ataxia is of an aggravated character he at once falls over as soon as the sight is withdrawn. The upper extremities are usually much less affected. There is a want of precision and an appearance of awkwardness in their movements. This is particularly noticeable when manipulations are attempted that require some nicety in their execution, such as buttoning a sleeve or threading a needle.

The Reflexes. There may be no diminution of the reflex excitability of the skin, but it is remarkable that the tendon reflexes in typical cases of ataxia are abolished. To test the "knee jerk," the individual is requested to cross one leg over the other at the knees so that the upper limb hangs loosely downward. A slight tap on the patella will in healthy persons evoke a more or less vigorous movement of the limb. The abolition of the "knee phenomenon" in loco-motor ataxy is a symptom of great diagnostic importance.

Anæsthesia. There are few well-marked cases of ataxia in which this symptom is wanting. At least some of the different qualities of common sensation will be either found blunted or entirely abolished. Loss of tactile and muscular sensibility is common, and this explains the phenomenon why patients are unable to tell the position of their limbs when in bed or in the dark. On the other hand, there is an abnormal sensitiveness to changes of temperature. A more constant and obtrusive symptom than anæsthesia is an abnormal sensation of the nature of numbness. Patients compare it to a feeling of furriness at the soles of the feet, as if they were standing on a soft cushion or a bag filled with air. In the hands the sensation simulates the impression of being covered by gloves.

The Genito-urinary Symptoms. Signs of irritation of the bladder, as has already been mentioned, belong to the earlier stage; but as the disease progresses, the frequency and urgency of micturition give way to incontinence with all its serious consequences. The sphincter of the rectum suffers less.

Increase of sexual excitement has been noticed at the commencement of the disease; finally, however, complete impotence supervenes.

Trophic Disturbances. The friability of the bones in ataxic persons must be attributed to trophic changes. Charcot has drawn attention to a form of joint disease, usually affecting the knee, which is probably of a similar origin.

"*Crises Gastriques.*" Intercurrent attacks of gastralgia, nausea and vomiting, are not seldom observed during the course of the disease.

Explanation of the Symptoms. In view of the distinctive lesion that characterizes loco-motor ataxy, it might, at first sight, be thought an easy task to propose an adequate theory of this disease. But such is not the case. No doubt the pain and the anæsthesia must be ascribed to the pathological changes in the posterior columns and nerve roots. But our imperfect knowledge of the physiology of the spinal cord is evidenced by the difficulty of adequately explaining the essential symptom of the disease—the ataxic movements. There are no evidences to show that the cord contains centers of coordination. Leyden refers the symptoms of incoordination to the anæsthesia resulting from the degenerated condition of the posterior columns and nerve roots; for it is well known that motor functions are materially

influenced by sensitive impressions. It is objected that ataxic movements may exist without defect or loss of sensibility, and conversely that disease of the posterior columns of the cord is not always attended by symptoms of incoordination. Brown-Sequard arrives at the conclusion that the destruction of the nerve fibres which connect the posterior and anterior roots disturbs the reflex mechanism which is engaged in the acts of walking and standing. This theory presupposes the implication of the grey substance.

It may be broadly assumed that the starting point of the disease is the existence of a parenchymatous degeneration of the cord, probably of an inflammatory character. The pathological changes, as judged by the order of the morbid phenomena, progress both in a longitudinal and transverse direction, causing the functional disturbances that constitute the symptomatology of the disease.

Diagnosis. A typical case of loco-motor ataxy presents such clearly cut clinical features that it can be easily distinguished from any other form of spinal disease. The differential diagnosis is attended with difficulties in those mixed cases in which the symptoms of ordinary myelitis complicate the ataxic phenomena. At an early stage when the signs of incoordination are wanting, and only the sensory disturbances, the pain and anæsthesia represent the disease, the diagnosis will be rendered doubtful. It is well to remember, however, that the existence of a double sciatica should direct attention to the spinal cord, and those tests should be tried which are likely to elicit ataxic symptoms.

Prognosis. Experience confirms the bad prognosis which must *a priori* be entertained of a disease which is marked by progressive destructive changes. Still the forecast need not be so absolutely gloomy, for loco-motor ataxy assumes sometimes a very mild character, and under favorable circumstances the extent and severity of the morbid alterations may be checked. There are patients who survive for many years; and, though recovery cannot be expected when the disease is once fully established, yet by the avoidance of those habits and indulgence which are detrimental to the general health, and the employment of remedies for the relief of the pains and the vesical irritation, the hope of prolonging life may be reasonably entertained.

Treatment. The early recognition of the disease, which our better acquaintance with its initiatory symptoms has now rendered easy,

affords the opportunity of adopting those measures that tend to arrest its progress. Above all things the patient should consider himself an invalid and abandon any avocation which calls for active physical exertions. The benefit derived from change of occupation I have lately witnessed in the case of a man who was daily engaged in loading and unloading heavy packages at a railway depot, and who was in the habit of taking a rest by lying down on the cold and damp flooring of the building. The paroxysms of atrocious pains in his lower extremities, the irritability of his bladder, and the commencing unsteadiness of his gait remarkably improved from the time that he quit work. He was ordered to take gentle outdoor exercise in favorable weather and to abstain from sexual indulgence.

The practice of applying moist cups, or the actual cautery, to the spine has yielded no encouraging results. Many observers speak favorably of the hydropathic treatment. This may be carried out at home by sponging the spine, but the water should be of a moderate temperature. Thermal baths are not advisable. Potassium iodide deserves a trial at an early period. Nitrate of silver stands in greatest repute in this disease. The dose should be gradually increased, and the usual caution observed to prevent bronzing of the skin. Strychnia has not been found of benefit, though it is certainly indicated in ocular paralysis. Ergot is recommended by Brown-Sequard. Hammond saw benefit from the administration of ter-chloride of gold. The free employment of anodynes for the mitigation of the eccentric pains cannot be avoided. Weir Mitchell speaks in favor of absolute rest.

Multiple Sclerosis of the Brain and Spinal Cord (Sclerose en Plaque).

Anatomical Changes. The lesion characteristic of this disease consists of a number of translucent, yellowish or greyish patches of firm consistence and of variable size which affect different portions of the brain and spinal cord. They are sometimes found in the medulla oblongata, the cerebellum, the basal ganglia, the pons, the cerebral peduncles, the optic nerve and in the trunks of peripheral nerves. When the sclerotic patches are limited to the brain, they involve by preference the white substance of the hemispheres and the nuclei of the cranial nerves arising from the floor of the fourth ventricle.

The plaques under the microscope are found to be composed of

increased and thickened interstitial tissue and atrophied nerve elements. These morbid alterations are more marked in the center than at the periphery of the patches. Numerous nerve fibres are deprived of their medullary sheaths, the axis cylinders are shrunken and in some places they have entirely disappeared. The ganglionic cells resist the degenerative changes longer, but finally shrivel and many of them are destroyed. The bloodvessels are also implicated in the sclerotic process. Their coats are thickened and infiltrated with pigment granules and fat. The neuroglia is changed into an extremely dense mass of fibrous tissue where it surrounds and firmly compresses the remaining nerve elements. Compound granule corpuscles and corpora amylacea are constant constituents of the sclerotic patches. They contain, besides, a moderate number of oval nuclei and numerous stellated bodies of large size (Deiter's cells).

Etiology. Sclerosis occurs most frequently between the ages of twenty and thirty years. According to the experience of Charcot, more females are affected by the disease than males. Duchenne reports a case attributable to hereditary influence. Among the supposed exciting causes the following may be mentioned: exposure to a damp atmosphere; physical over-exertion; mental shocks; concussion of the body, and previous acute diseases.

In respect to the pathogenesis of sclerosis, opinions are divided concerning the primary morbid process that underlies the lesion. There are weighty considerations in support of the view of Rindfleish, that the anatomical changes begin in the bloodvessels and, secondarily, implicate the neuroglia and the nerve elements. According to Leyden, the pathological process of sclerosis is of the nature of an interstitial chronic myelitis, which at first affects the neuroglia and finally involves the nerve elements.

Clinical History. In consequence of the very gradual development of sclerosis, it is only after the disease has made considerable progress that prominent symptoms make their appearance. When the lesion affects the brain first, no reliable conclusion can be drawn in reference to the source of the cerebral irritation. And, likewise, when the spinal cord is the starting point of the degenerative process, which happens in the majority of cases, nothing definite can be inferred from the existence of mere muscular weakness of the lower extremities. Occasionally the manifestations of sclerosis date from an apoplectic or convulsive seizure. Sensory disturbances are but rarely witnessed throughout the whole course of the disease.

Of great significance is a peculiar tremor which affects the patient whenever he attempts to carry out a movement. It ceases as soon as he relinquishes the effort. Thus, on rising from his seat or moving his limbs, the trembling at once begins. Upon grasping a glass of water to bring it to his lips, the arm is seized by a violent shaking which spills the fluid, and if he succeeds in carrying the glass to his mouth it clatters against his teeth. Oscillation of the eyeballs (nystagmus) is observed in about half the cases. This is also a symptom of motor irritation like the tremor.

A singular defect of speech is a constant symptom in the cerebro-spinal form of the disease and is of great diagnostic value. Words are pronounced in a hesitating, drawling manner, a pause being made as in scanning between each syllable.

The act of walking imposes considerable effort on the patient and quickly tires him out. There is an awkward, shovelling kind of gait, and, in some cases, the erect position cannot be maintained without some support. At a later stage, or in severe cases at an early period, walking becomes simply impossible. The muscles, especially the flexors and abductors of the thigh, are suddenly seized with a remarkable rigidity that foils for a time the efforts at locomotion. Finally the flexors become similarly affected, causing permanent contractures, so that the heels touch the nates or the thighs remain bent upon the trunk. Dorsal or eccentric pain is not a conspicuous, or at least not a constant symptom of sclerosis. Formication of the extremities is rather more common. Disturbances of vision, chiefly amblyopia and diplopia, depending upon partial paralysis of ocular muscles, are of an evanescent character.

Occasionally some of the patients break out in fits of sobbing and crying without an assignable cause.

The sphincters are seldom enfeebled, and the sexual functions in the majority of cases remain unimpaired.

Although a typical case of multiple sclerosis is easily recognized, yet it is well to bear in mind that its symptomatology varies in accordance with the extent and distribution of the lesion. Sclerosis of the medulla oblongata gives rise to a very serious set of symptoms. There is paralysis of the tongue, difficulty of deglutition and embarrassment of the respiration. Psychical and motor disturbances identical in character with the peculiar combination of symptoms distinctive of general paralysis of the insane, not infrequently develop at a late period of the disease.

The symptoms of an ordinary myelitis develop in the event of the spinal cord being affected by central sclerosis.

Diagnosis. Sclerosis is more likely to be confounded with paralysis agitans than with any other affection of the brain or spinal cord. There is certainly much resemblance between the tremors that characterize both diseases. The distinction rests on the circumstance that the tremor of sclerosis is only evoked when the patient makes a movement, while the tremor of shaking palsy is continuous, whether the patient is in motion or at rest. Another distinguishing feature is the difference in the time of life at which these diseases develop. Sclerosis is an affection of the early period of life; paralysis agitans attacks persons of an advanced age.

The irregular and grotesque movements of chorea can hardly be likened to a tremor. Choreic patients are spontaneously impelled to perform purposeless actions, which is not witnessed in sclerosis.

There is only a superficial resemblance between ataxia and multiple sclerosis. A mistake is scarcely possible, considering the clinical peculiarities of these several affections.

Prognosis. The only encouraging feature in the prognosis of sclerosis is the frequent improvement of the symptoms during the protracted course of the disease. Serious implication of the medulla oblongata speedily tends to a fatal termination. The average duration is about four years.

Treatment. Therapeutics has hitherto met with little success in the treatment of sclerosis. If the earlier symptoms of the disease did not usually elude observation, considerable benefit might probably be derived from mild antiphlogistic measures. After the degenerative process is once established there is but faint hope to arrest its fatal tendency. The remedies which deserve some confidence are potassium iodide, nitrate of silver, cod-liver oil and strychnia. Great improvement of the symptoms has been observed from sea bathing and electricity.

Spasmodic Spinal Paralysis (Lateral Sclerosis).

Anatomical Changes. It is yet undecided whether the disease which Charcot attributes to sclerosis of the lateral columns, and which Erb describes under the name of "spastic spinal paralysis," is due to morbid changes analogous to "multiple sclerosis," or to a

pathological condition identical with the "secondary degeneration" of Tuerk.

Clinical History. The essential symptoms of the disease consist of muscular weakness of the limbs in the early stage, and spasmodic rigidity, especially of the lower extremities, at a later period. The paresis is evidenced by the sluggishness of movements and an unusual sense of fatigue, of which the patient complains after standing and walking. There is marked increase of the tendon reflexes. Twitching and stiffness of the affected muscles supervene, which seriously interfere with locomotion. The patient is liable to stumble over slight unevenness of the ground. He seems to walk on stilts, gets hold of objects to steady himself and, finally, is only able to hop about. As the disease progresses the rigid and spastic condition of the muscles increases, so that the limbs become fixed in the extended position.

Diagnosis and Prognosis. Spastic spinal paralysis presents an assemblage of well-defined symptoms, which render its distinction from allied affections of the cord a matter of little difficulty. The muscular weakness and stiffness assume sometimes a hemiplegic character, which circumstance may for a while embarrass the diagnosis. But it must be remembered that the paresis starts in the lower extremities, there are no brain symptoms, and none of the cranial nerves are affected. From ordinary chronic myelitis it can be distinguished by the absence of disturbances of sensibility and by the integrity of the sphincters and the sexual functions. Loco-motor ataxia and progressive muscular atrophy occur as complications. The prognosis is more favorable than it is in other organic diseases of the cord.

Treatment. The therapeutics of this affection resolves itself into that of chronic myelitis. Central galvanisation and the cold water treatment take the first rank among the remedial measures. Strychnia is contraindicated.

Progressive Muscular Atrophy (Wasting Palsy).

Anatomical Changes. A peculiar wasting of muscles in different parts of the body was first recognized by Aran as a distinctive disease. But the first intimation of its morbid anatomy came from Cruveilhier, who declared it to be a spinal affection. For a complete

account of its symptomatology we are indebted to Duchenne. The results of later investigations tend to confirm the opinion that the fundamental lesion of progressive muscular atrophy consists of degeneration of the anterior grey columns. The changes under the microscope showed in some reported cases pigmentary atrophy of nerve cells of the anterior horns and the anterior nerve roots. The atrophied muscles exhibit marked anatomical changes. Their striæ are indistinct, and many bundles of muscular fasciculi are of a pale color and of a gelatinous consistence. Normal muscular fibres are found alongside of others which have undergone fatty degeneration. In the most atrophied portion of muscles nothing is left but the empty sarcolemma.

Secondary forms of progressive muscular atrophy develop from lesions of the cord that eventually involve the anterior grey columns. This complication has been observed in labio-glosso-pharyngeal paralysis, loco-motor ataxy, cerebro-spinal sclerosis, and in other examples of degeneration of the cord in which the primary lesion extended forward.

Clinical History. The wasting in a typical case of progressive muscular atrophy begins in the hands and fingers. At first the ball of the thumb and then the hypothenar eminence disappear. On extending the hands, the fingers assume a claw-shaped appearance (main en griffe), in consequence of atrophy of the interossii, which keeps the last phalanges in a state of flexion. The atrophy next invades the wrist, the extensors of the forearm, and then the muscles of the shoulder and the back, causing flatness and depression of the shoulder. Travelling downward, the atrophy attacks the muscles of the trunk, and finally those of the lower extremities.

The irregular order of the atrophy gives a characteristic appearance to the contour of the body. A muscle or part of a muscle wastes whilst its next neighbor remains unaffected. The bellies of the sound muscles strangely contrast with the groove left by the muscles that are wasted. Bones and tendons become prominent in situations where the volume of the muscles is diminished.

Corresponding with the extent and intensity of the atrophy there is a functional weakness of the muscles which does not amount to true paralysis, though the patient is finally reduced to a pitiable state of helplessness. But for a long time he is still capable of carrying out movements by means of supplementary muscles that yet retain their structural integrity. A striking instance of this I observed

in the case of the so-called "living skeleton" who was exhibited in this city. When his head dropped on his shoulder he could swing it back again to the erect position by a violent jerk. On attempting to rise from his seat he had the trick of twisting his body, which brought him to his feet.

Fibrillary twitchings in the muscles occur early and constitute a notable symptom of the disease. Spasmodic contractions of muscles or groups of muscles are also occasionally witnessed.

A dull, diffuse pain in the muscles, which ultimately become atrophied, is usually mistaken by the patient for "rheumatism." This pain is sometimes of a lancinating or boring character. To the subjective symptoms belong also a creeping sensation in the fingers and numbness of the hand and arm. But all these disturbances of sensibility are thrown into the background by the prominence and importance of the muscular wasting.

Inequality of the pupils has been observed in a small number of cases, contraction more frequently than dilatation.

Electric exploration of the diseased muscles yields very interesting results. In general it may be said that the electro-muscular contractility decreases in proportion to the intensity of the atrophy. So long as there are some muscular fibres left, a slight contraction can be obtained; but a completely atrophied muscle, or one which is replaced by infiltrated fat, ceases to give responses to either current. Increased galvanic excitability has been noticed in some cases, but on the other hand, decided diminution of electric reaction is occasionally observable in muscles before they begin to atrophy.

Etiology. Men in their best years, who are actively engaged in occupations that require hard labor, are the usual victims of wasting palsy. Charcot traced most of his cases to the influence of heredity. Progressive muscular atrophy has also been observed to develop after typhoid fever, diphtheria, rheumatic fever, and other acute affections.

Diagnosis. To guard against diagnostic errors it is important to keep in view the peculiar clinical history of progressive muscular atrophy. It is a bilateral disease, and produces singular deformities of the trunk and limbs, resulting from the disappearance of entire muscles or parts of muscles. Muscular wasting is not an uncommon symptom in a number of spinal affections, but its mode of development deviates from that of the progressive type.

In lead palsy affecting both upper extremities there is "wrist drop," but no deformity of fingers as in wasting palsy; the extensors of the forearm, and not the small muscles of the hand, are atrophied, and there is complete loss of the electric excitability in the atrophied muscles; whilst in progressive muscular atrophy, owing to unaffected fasciculi of muscular fibres, there is still a response, however faint. There is besides a history of exposure to the poisonous influence of the metal in lead palsy.

Prognosis. Cases in which the atrophy shows a tendency to become rapidly general give a very unfavorable prognosis. Patients may survive for many years if the disease is of a mild character and makes frequent pauses in its progress. Implication of the muscles of deglutition and respiration directly endangers life. Recoveries, even under the most favorable conditions, are exceptional.

Treatment. Erb's emphatic declaration that electricity is the only remedy we possess against progressive muscular atrophy, and Duchenne's prior recommendation to begin the treatment at once with strong faradic currents, express the general opinion of the inefficacy of any other therapeutical measure in this disease. It is now the practice to prefer a descending galvanic current with frequent interruptions—the positive pole being applied to the vertebral column and the negative pole to the muscles. Duchenne is so strongly convinced of the beneficial action of electricity even in advanced cases of the disease that he expects decided improvement from energetic faradisation so long as the affected muscles respond to the current.

Pseudo-Hypertrophy of Muscles (Lipomatous Hypertrophy of Muscles).

This is a peculiar type of muscular atrophy in which the wasting is replaced by an enormous development of fat, so that the muscles appear to be greatly hypertrophied. The gastrocnemii frequently present an extraordinary degree of fullness and rotundity, and yet the muscular weakness is such that the patient finds great difficulty in standing and walking.

Etiology. Children of a tender age and of the male sex are almost exclusively affected by this disease. A hereditary tendency is undeniable.

Anatomical Changes. The most degenerated muscles appear to be composed entirely of fat. A few isolated muscular fibres may be found here and there. The less deteriorated muscles consist of muscular bundles of normal structure, but separated by interposed fat. These muscles are of a soft consistence, and of a pale yellowish or reddish color. No morbid alterations are found in the nervous system. Pathologists are of the unanimous opinion that the disease originates in the muscles; though it is undecided whether the morbid process is of the nature of hyperplasia of the interstitial tissue which compresses and atrophies the muscular fibres, or whether this change results from the excessive deposit of fat.

Clinical History. As the disease invariably begins in the lower extremities, and occurs, in the majority of cases, in early youth, parents will inform us that the child was slow in learning to walk, that it constantly tripped and fell, and experienced much difficulty in mounting stairs. Very marked symptoms are observed as the disease progresses. The gait is unsteady and waddling. When leaning forward the body doubles up like a jack-knife. The hands are pressed against the knees in the effort to regain the erect position. In standing or walking there is a peculiar posture of the body which the patient instinctively adopts to steady himself. The shoulders recede and the abdomen is thrown forward, thus resembling in miniature the position of a woman in the last months of pregnancy. On witnessing the efforts of the little patient to sustain his balance in the acts of standing and walking (in which he but poorly succeeds), one is surprised at the enormous volume of the calves of the legs. Other muscles of the lower and upper extremities and of the trunk are found in a similar condition, but those of the neck and head are exempt. It is remarkable that the affected muscles still retain their electro-muscular contractility. No other noteworthy symptoms are observed throughout the course of the disease. The general health continues satisfactory. The disease slowly progresses until patients are consigned to their beds for life.

Treatment. The very few favorable reports concerning the treatment of this disease come from electro-therapeutists. Nothing need be added here to what has already been mentioned on the subject of electrical treatment in progressive muscular atrophy.

CHAPTER X.

DISEASES OF THE MEMBRANES OF THE BRAIN.

Pachymeningitis.

Suppurative inflammation of the external layer of the dura mater is a secondary affection, resulting from traumatic lesions and diseases of the cranial bones.

When the internal layer of the dura mater is the seat of the inflammatory process, a fibrous exudation is thrown out, which, on becoming organized into a false membrane of great vascularity, gives rise to hemorrhages. The hematomatous tumor which is thus formed compresses the cortex, causing softening and discoloration of its tissue.

Internal pachymeningitis is, in the majority of instances, also of a secondary nature. It arises from injuries and disease of the skull. Chronic alcoholism favors its spontaneous development, especially in old persons.

Clinical History. The symptomatology of internal and external pachymeningitis is identical with that of simple meningitis; but when the former develops slowly and insidiously it cannot be clinically distinguished from intracranial tumor. At any rate, the symptoms point then to the existence of serious brain trouble of an obscure nature. There is severe headache, mental obtuseness, incoherent speech, feebleness of the limbs, and progressive emaciation. These symptoms are subject to remissions and exacerbations, and occasionally apoplectic attacks occur. Failure of the mental powers, embarrassment of respiration and difficulty of deglutition constitute phenomena of the gravest import. Death is sometimes preceded by convulsions and coma.

Simple Meningitis.

Simple or primary inflammation of the pia mater is not a disease of frequent occurrence. Traumatic meningitis is far more common. Secondary forms of acute meningitis develop from intracranial

diseases, and occur in the course of different acute affections. Chronic meningitis is not easily recognized during life. There is a basilar meningitis, the *lepto-meningitis infantum*, whose etiology is obscure.

Anatomical Changes. The morbid alterations in simple meningitis are, as a general rule, limited to the convexity of the brain. The pia mater is greatly injected and infiltrated with pus. Thick yellowish pus is also found in the subarachnoid spaces and along the course of the meningeal bloodvessels. The arachnoid has an opaque appearance and is filled with the purulent exudation. Spots of softening occur in the substance of the brain where the inflamed pia is closely adherent to the cortex.

Clinical History. Simple meningitis has few premonitory symptoms. There is an initial chill, though it may be absent. The onset usually begins with violent headache, febrile excitement, vomiting and nervous prostration. From the beginning the disease assumes a serious aspect. The patient is restless and irritable; he shuns the light and is annoyed by loud sounds; the eyes glisten; the pupils are contracted; the skin is hot and dry; a circumscribed flush is seen upon the cheeks; the breathing is hurried, or rather panting; the intelligence is impaired; speech is slow and at times incoherent, and an active delirium soon sets in. Oscillation of the eyeballs and strabismus are frequently observed. The cutaneous sensibility is much increased. Even in a state of apathy the patient evinces the signs of hyperæsthesia and of heightened reflex excitability.

Motor disturbances of an irritative character are witnessed so soon as the disease is fully established. They consist of stiffness of the muscles of the neck, retraction of the head, twitching of the muscles of the upper and lower extremities, and, toward the end, subsultus tendinum and tremors. Infants roll the head from side to side or bore it into the pillow, and utter piercing cries. General convulsions are liable to supervene in these little patients; sometimes there is trismus; the fontanels are distended, the vomiting continues; the bowels are constipated and the urine is scant.

Among all these symptoms during the stage of cerebral excitement none is so conspicuous and constant as the headache. The pain may be fixed to one spot or be diffused, but patients always complain, so long as they are conscious, of its great intensity and unbearable character.

With the increase of the exudation and ventricular effusion,

somnolence and torpor take the place of the symptoms of cerebral irritation. The pupils are now dilated, the pulse is rapid and intermittent, the respiration irregular, and the urine is often retained. These signs of cerebral compression are frequently followed by paralysis of the hemiplegic type, and finally profound coma closes the scene.

Acute meningitis occurring in persons of an advanced age presents certain peculiarities. The symptoms are not well marked and develop insidiously. There is little or no headache, the fever is moderate, but active delirium sets in early and may be quickly succeeded by fatal coma. In other cases there is merely mental confusion, a vacant expression of the countenance, tremor, much restlessness, and a rapid sinking of the vital powers.

Meningitis is also one of the manifestations of cerebral syphilis.

Very dangerous cephalic symptoms occasionally light up during an attack of inflammatory rheumatism, which may be taken for those of meningitis; but post-mortem examination does not confirm this supposition. The affection is characterized by a high grade of febrile excitement, a busy delirium and restlessness. Headache and vomiting are absent. I saw a case answering to this description in a young man who had gonorrhœal rheumatism. The patient was very loquacious and slept but little. He ceased to complain of pain in his swollen knee and had no headache. He soon fell into a state of coma in which he died.

Diagnosis. It is a difficult point in differential diagnosis to distinguish acute meningitis from acute encephalitis. Practically this is of little moment, for inflammation of the pia mater usually involves the substance of the brain.

Delirium tremens is distinguished by the tremor, the characteristic hallucinations and the absence of the headache. There is besides a previous history of inebriation.

In typhoid fever the headache is far less intense than in meningitis, and there is a typical range in the rise of the temperature. It is only in the early stage of typhoid when a doubt can arise. This will at once be removed on the occurrence of the diarrhœa, the appearance of the roseolar spots, and the tenderness and gurgling in the right iliac region.

Much as the simple and tubercular meningitis have in common, there are, nevertheless, points of distinction which will be mentioned when the latter disease is discussed.

Prognosis. Acute meningitis is an exceedingly grave disease. Very few cases recover. Death may take place within forty-eight hours. Generally, however, the fatal termination occurs at the end of the first week, though exceptional cases may linger for two or three weeks and even longer. Recoveries do occur, but mental impairment is apt to remain, probably from development of chronic meningitis.

Treatment. It is at the onset of simple meningitis that remedial measures, promptly carried out, offer any prospect of success. Among them, none are held in higher estimation by experienced practitioners than bloodletting, brisk purging, and cold applications to the head. A vein should be opened in the sitting posture and allowed to bleed until signs of faintness make their appearance. The venesection may be repeated if thought advisable, or leeches may be applied to the temples or behind the ears to keep up the effects of the depletion. An energetic purgative accomplishes the same end. To insure prompt action, a full dose of calomel or the compound infusion of senna should be given.

However much prejudice may be felt against the adoption of such harsh measures, they are justifiable in a desperate disease like that of acute meningitis, for which we have nothing better.

To derive the greatest amount of benefit from the application of cold to the head it is insufficient to use a rag soaked with water. A bladder filled with crushed ice to which salt is added is immeasurably superior. But the ice-helmet answers the purpose still better. There is another mode of applying cold to the head which nothing else can exceed in its calming and soothing effect. This is accomplished by letting a small stream of water fall on the head for a limited time. But irrigation is not adapted to children and old persons; used, however, with proper caution, to avoid its too great depressing effect, the speedy subsidence of the restlessness and jactitations of the patient is astonishing to witness. Before making these applications to the head, the hair should be cut. As an adjuvant, woollen cloths wrung out of hot water should be wrapped around the lower limbs.

Blistering is indicated when coma threatens to set in. A cap of fly-plaster may be applied to the shaven head, or blisters may be drawn on the nape of the neck and behind the ears. At this time, purgatives should be discontinued.

The stage of collapse must be met by stimulants, though they avail but little.

Tubercular Meningitis.

Anatomical Changes. Formerly the term "acute hydrocephalus" was applied to a basilar meningitis occurring in childhood. It is now ascertained that, in the great majority of cases, the exciting cause which sets up the inflammatory process is the development of miliary tubercles in the pia mater. The grey granulations are found in greatest abundance in the basilar portion of this membrane. They can be readily detected when the pia is stripped from the brain. Sometimes they are found dotted over the whole surface of the brain and between the convolutions. Wherever they occur they invariably follow the course of the bloodvessels. The tubercles also appear in the form of conglomerated masses of different sizes which are more or less degenerated. In this condition they are often found mixed with the inflammatory exudation. In other respects the anatomical changes distinctive of tubercular meningitis are of an analogous character with those of the simple variety. A copious effusion is usually found in the ventricles. In general tuberculosis many of the internal organs show the presence of miliary granulations. They are never absent from the lungs.

Etiology. Tubercular meningitis occurs with the greatest frequency between the second and seventh year, though adults are not exempt from it. Heredity and unfavorable hygienic influences predispose to the development of this disease. From the fact that tubercles of an older date are not infrequently found at post-mortem, it is inferred that their presence may be tolerated until, through some exciting cause, they light up the meningeal inflammation. It is a matter of experience that children, under the debilitating influences of the various affections to which their age renders them liable, not seldom succumb to tubercular meningitis.

Clinical History. It is customary to divide the history of tubercular meningitis into three stages. The first stage includes the symptoms of cerebral irritation; the second stage is marked by the effects of compression which the exudation exerts on the brain; and the third stage, or the stage of collapse, refers to the final paralysis of important nerve centers. In cases which take a typical course all these different phases of the disease are presented in regular succession. But the sudden or slow development of the exudation, the variable extent of the cerebral lesion, and the degree of mechanical

compression, constitute variable factors that greatly modify the symptomatology of the disease in individual cases.

In the adult the disease may begin suddenly with acute symptoms. A severe chill is rapidly followed by a high temperature and the signs of cerebral irritation. In small children the disease is occasionally ushered in by violent vomiting and general convulsions. But in the majority of cases the complete establishment of the disease is preceded, for an indefinite period, by groups of symptoms which result from the slow progress of the meningeal inflammation. These premonitory symptoms are usually not of a character to occasion alarm. Far more frequently they will be attributed to difficult dentition, gastric derangement, irritation of the bowels, or to an ephemeral febrile affection. A child is noticed to emaciate, to lose its appetite, and be troubled with irregularity of the bowels. The tongue is coated, the thirst increased, there is nausea and occasional vomiting. In the evening the temperature rises; the pulse is accelerated; sleep is disturbed by starts and cries, and during the daytime the child appears languid and drowsy. An older child shows irritability of temper; complains of headache; frequently abandons its playthings and sleeps at unusual hours. Infants at the breast are apt to chew the nipples, to suck with great avidity for a little while and then to suddenly let go their hold. The milk is often regurgitated immediately after nursing. They either doze continually or cry incessantly. Sometimes they are subject to convulsions of brief duration. Many of these phenomena disappear for a short period; but the improvement is delusive. The established disease is characterized by symptoms which unmistakably indicate an acute cerebral affection.

Headache stands first in the rank among the initial symptoms. It persists with slight abatement so long as the patient is at all conscious. The pain is felt most intensely in front. The facial expression bears witness to its severity. Some patients break out in loud lamentations, grasp the head tightly with their hands or bury the face deeply into the pillow. I saw a little girl beating her forehead with her fists, from which she would not desist for days.

The cephalalgia is attended, in many instances, by vertigo. This swimming of the head is aggravated when the patient rises.

Vomiting is also one of the most constant symptoms at the outset, at least in children who have not vomited before.

Obstinate constipation of the bowels is the rule, though I have

repeatedly observed cases during the summer months ushered in by a profuse diarrhœa which simulated an attack of cholera infantum. At this stage a morbid sensitiveness to light and sound and cutaneous hyperæsthesia constitute well-marked symptoms. Contraction of the pupils is rather common. The pulse is moderate, especially in the adult. It is sometimes but 60 beats to the minute. In children the pulse is rapid, wiry and frequently intermittent. The range of the temperature runs parallel with the pulse. The respiration in infants is hurried, interrupted and sighing. There is a tendency to somnolence. Older children are wakeful and restless. At the onset and for the following few days there is little psychical disturbance; but as the disease progresses, an apathetic condition is observed in grown persons. The intelligence becomes obtuse, the speech hesitating, and the patient dislikes to answer questions. In individual cases a very active delirium develops. Patients constantly throw off the bedding, jump out of bed and attempt to leave the room. The duration of the first stage averages about eight days.

Certain prominent symptoms now make their appearance significant of the stage of compression. It is highly probable that the sudden slowing of the pulse in the adult, and the dilatation of the pupils at this stage, result from ventricular effusion. The tendency of the child to bore the occiput into the pillow, the retraction of the head, or opisthotonos, indicate basilar exudation. At this time the vomiting ceases and does not return. The face, finger and toe-nails become cyanotic, the features are pinched, the eyelids half closed and the eyeballs fixed and turned upward. Strabismus is usually an earlier symptom. At intervals the hydrocephalic cry is heard, although the somnolence increases. Ophthalmoscopic examination of the fundus of the eye frequently detects miliary tubercles of the choroid, and neuro-retinitis. The "tache cerebral" is sometimes well marked. Deglutition begins to be performed with difficulty. The respiration is sometimes remarkably slow or irregular. A very characteristic symptom is the sunken (boat shape) appearance of the abdominal walls. Slight spasmodic movements of the limbs and of the facial muscles, or repeated attacks of general convulsions in small children, are not seldom present at this period. Facial paralysis and ptosis may also occur. In infants, very curious movements of an automatic character are occasionally witnessed, such as a rhythmical waving of the arm across the face, or a steady pressure of the back of the hand on the eye. The duration of this stage

varies; in the greater number of cases it is about a week. Individual cases occur in which there is no period of transition between the first and third stages. Occasionally some of the grave symptoms disappear for a few days; but the improvement is deceptive.

The third and final stage is marked by symptoms of general paralysis. Swallowing of food is now impossible; the reflexes are abolished; the evacuations pass away involuntarily; the abdomen is tympanitic; the skin is cold, and covered with a clammy sweat; the pulse is exceedingly rapid and thready; the coma profound; convulsions repeatedly occur, and, under these symptoms of utter collapse, death takes place within twenty-four or forty-eight hours.

Diagnosis. There are few acute diseases of infancy that offer greater difficulties to diagnosis than the prodromic period of tubercular meningitis. A decisive judgment in respect to the nature of the symptoms will often be held in suspense until it becomes clear that they neither mean the cutting of a tooth nor intestinal irritation caused by worms, nor gastric trouble, nor any other trifling cause. Under all circumstances it is advisable to inquire carefully into the history of the patient. There are families who lose their children, when of a certain age, as they say, from "brain fever." An obstinate cough or the evidences of scrofulosis point to the probable existence of the tuberculous diathesis.

The distinction from simple meningitis chiefly refers to the following points: Simple meningitis develops suddenly; the headache is intense; the delirium active; convulsions occur early, often at the onset, and the disease runs a short course. Tubercular meningitis develops slowly; the headache and delirium are not prominent symptoms; convulsions, as a rule, come on at a late period, and the duration of the disease occupies from two to three and sometimes four weeks.

Tubercular meningitis may be confounded with typhoid fever, especially as the premonitory symptoms of these diseases bear a close resemblance to each other. But typhoid fever can easily be distinguished by the gradual rise of the fever temperature, the diarrhœa, the rash, the iliac tenderness and the state of the tongue. At no time does typhoid fever present those evidences of brain compression which constitute such marked features of meningitis.

Prognosis. The few reported cases of recovery from tubercular meningitis testify to the gravity of its prognosis. Relapses occur

even in such exceptional cases, or idiocy and epilepsy remain for life. The fatal termination directly results from compression of vital nerve centers.

Treatment. From all sides the appeal is made to the family physician to put into practice the well-known prophylactic measures which tend to prevent the development of tuberculosis, since therapeutics fails to successfully grapple with this disease when once established. An infant with a hereditary predisposition to tuberculosis or scrofula should certainly be provided with a healthy nurse. Or, in case parents cannot afford to incur such an additional expense, it is even preferable to feed the child with diluted cow's milk. Superabundance of clothing and hot rooms should be avoided, as both have an enervating effect on the child. The opposite extreme of the so-called "hardening process" is just as reprehensible. Cool bathing and country air constitute a far more rational method of invigorating the system. Children should sleep in large, dry rooms that can be easily ventilated. A generous but a not too stimulating diet must be allowed.

The employment of an energetic treatment in this disease is obviously objectionable. Local abstraction of blood from the head gives only temporary relief to the cephalic symptoms. The application of cold to the head and an active purgative answer the same purpose. Iodide of potassium is a remedy which should not be withheld. Revulsives are indicated in coma, but little children should not be blistered.

Inflammation of the Sinuses of the Dura Mater.

This is a secondary affection. It occurs under circumstances which set up an adhesive or suppurative phlebitis that leads to thrombosis of the affected sinus. The extension of the inflammation from otitis media to the temporal bone may have a similar result. The variability of the symptoms renders it frequently impossible to recognize the true nature of the disease. It begins with signs of cerebral irritation characteristic of acute meningitis, and finally takes on the appearance either of a low typhoid condition or of pyæmia.

CHAPTER XI.

DISEASES OF THE BRAIN.

Cerebral Hyperaemia (Congestion of the Brain).

Increased flow of arterial blood to the brain is not a frequent pathological condition, and therefore its diagnosis should not be lightly made. It must be carefully distinguished from venous congestion of the encephalon. The former implies an active determination of blood to the head, such as results from opium, camphor, vinous stimulants, a full meal, simple hypertrophy of the heart, and the pyrexia of intermittent fever.

The distress caused by active cerebral hyperæmia is sometimes great. There is pain of the head, dizziness, throbbing of the temporal arteries, a flushed tumid face, and suffusion of the eyes. These symptoms occasionally pass into delirium. Persons of an excitable brain are very liable to suffer from this "rush of blood to the head." It is probably, also, induced by the direct influence of the rays of the sun to the head, though it must be remembered that "sun stroke" usually depends upon the depressing effect of immoderate heat.

Cerebral hyperæmia in early childhood simulates the leading symptoms of meningitis. It is attended by febrile excitement, restlessness or drowsiness and other cephalic disturbances. This condition can be traced to some palpable cause, usually to difficult dentition, the influence of cold, gastric or intestinal disorder, &c., and readily yields to the appropriate treatment.

Passive congestion of the brain is a secondary affection, invariably resulting from an impediment to the return of blood from the brain. This occurs in cardiac and pulmonary diseases which obstruct the venous circulation. The face in well-marked cases has a purplish tinge. The symptoms of cerebral excitement are due to a badly nourished and overburdened brain.

Cases are sometimes met with resembling "strokes of apoplexy," which may or may not be ushered in by convulsive seizures or active delirium; they occasionally prove fatal, and yet the autopsy only

reveals an abnormal fullness of the venous bloodvessels, which can hardly be considered an adequate cause of death. It is held to be permissible to give the diagnosis of "congestive apoplexy," before a coroner's jury, in cases of this kind. Trousseau was of the opinion that these so-called instances of congestive apoplexy are of an epileptic nature.

Treatment. Venesection used to be the indiscriminate practice in cerebral hyperæmia. The free abstraction of blood may be serviceable in young, robust persons of a florid complexion, who suffer from intense headache, violent action of the heart, and oppressed respiration. I have even seen prompt relief from general bleeding in patients complaining of cephalic symptoms due to hypertrophy of the heart, which no other kind of treatment would ameliorate. Such an active measure is, however, seldom required in cerebral congestion. Leeches to the head and brisk purgation suffice in the majority of cases. A course of aperient medicines is often of great benefit, when there is a tendency to determination of blood to the head. Alcoholic stimulants and strong coffee must be interdicted. An opposite plan of treatment is indicated in old persons, whose symptoms of cerebral hyperæmia generally result from weakness of the heart's action. This class of patients is benefited by brandy or rum punch.

The treatment in small children must be guided by considerations of their tender age and constitution. It is above all things important to keep in view the numerous exciting causes, however trifling, which in these little patients are exceedingly apt to induce functional disturbance of the brain.

Cerebral Anæmia.

Experimental researches tend to confirm the symptomatology which is thought to characterize cerebral anæmia. Compression of the carotids in the human subject causes pallor of the face, loss of consciousness, dilatation of the pupils, slow and sighing respiration, and sometimes vomiting and general convulsions. The sudden development of cerebral anæmia is witnessed in profuse hemorrhages, failure of the heart's action and during profound mental impressions; its gradual establishment results from chlorosis, prolonged lactation, and all chronic affections that impoverish the blood.

The brain and the membranes in cerebral anæmia present a pale appearance, which is particularly noticeable in the cortical substance.

Few or no puncta vasculosa are visible on section. There is usually an increase of the serous fluid in the ventricles and subarachnoid spaces.

Clinical History. Cerebral anæmia, in its extreme aspect, is witnessed in sudden loss of large quantities of blood. There is a deadly pallor of the face, the eyes are sunken, the sight becomes dim, the respiration is slow and sighing, the pulse feeble and thready; there is a disposition to drowsiness, and vomiting not seldom occurs.

The fainting fits resulting from powerful mental impressions, or rather emotional shocks, are examples of what may be called acute cerebral anæmia. Of a similar nature is the syncopal attack of the medical student who for the first time witnesses a bloody operation in the surgical clinic. The semi-unconsciousness, the clenched hands and twitchings of the facial muscles may be mistaken for the symptoms of an epileptic fit. Suddenly elevating the head of a patient in the early convalescence from typhoid fever may be followed by a fatal result from cerebral anæmia.

The slow development of cerebral anæmia is attended by headache and drowsiness; mental and physical efforts become irksome and distasteful, and the temper is irritable. Incomplete respiration causes frequent gaping. The appetite is indifferent, and sometimes nausea and vomiting supervene. Hallucinations of sight and hearing are not uncommon in severe cases, especially in females.

The "hydrocephaloid" of Marshall Hall is a form of cerebral anæmia which appears in small children during the course of exhausting diseases, especially cholera infantum. There is a stage of excitement in which the head is hot, the face flushed, the pulse rapid, the sleep disturbed, and the general sensibility much increased. This is succeeded by signs of depression, pallor, and coldness of the surface of the body, a small pulse, slow respiration, and sluggishness of the pupils. The child lies quietly on its back in a sort of stupor with the eyelids partly closed. The symptoms apparently point to the existence of serious brain trouble; but if the true state of the case be promptly recognized, they usually yield to appropriate treatment.

Treatment. Ordinary fainting fits quickly subside if the patient be placed in a recumbent position and cold water dashed into the face to excite reflex acts of respiration. In cases of unusual severity the

head should be lowered and the feet elevated. Ether and camphor, aromatic spirit of ammonia, or brandy, should be repeatedly given. The hypodermic injection of ether has a more prompt effect.

Hydrocephaloid, during the stage of cerebral excitement, demands the cautious application of cold to the head, which must at once be abandoned when symptoms of depression make their appearance. The latter require a supporting and tonic treatment. Milk-punch forms an excellent article of diet in these cases.

The treatment of the anæmic condition of the brain, when it depends on general anæmia, is obvious enough. Sufficient rest, fresh air, and a generous diet are indispensable. The reputed tonics, iron, quinia, and cod liver oil do excellent service. To improve the digestive functions it is advisable to order pepsin, pancreatin or malt extract. The stomach should not at once be overwhelmed by full meals and large doses of medicine.

Cerebral Hemorrhage.

Apoplexy. The apoplectic condition occurs under a variety of circumstances. Its principal phenomena embrace loss of consciousness and insensibility. In addition other symptoms of minor importance are frequently witnessed which relate to the state of the pupils and alterations of the pulse, respiration and temperature. When this combination of symptoms is accompanied or followed by paralysis, it is popularly named "a stroke of apoplexy." The great majority of cases of apoplexy is the result of extravasation of blood into different parts of the brain. It is, therefore, proper to adopt the more precise nomenclature of "cerebral hemorrhage."

Etiology. The chief factor concerned in rupture of a cerebral bloodvessel and consequent effusion of blood into the substance of the brain, is a diseased condition of the small arteries. Degenerative changes of a sclerosed or atheromatous character cause thinning and bulging of the vascular walls, which lead to the formation of circumscribed dilations of the arterial coats. These 'miliary aneurisms,' as they are called, vary in size from a millet seed to a pin's head, and occur isolated or in large numbers. Their brittle condition renders them liable to rupture, which is favored by any cause that increases the blood pressure.

The greatest mortality from cerebral hemorrhage occurs in advanced life. The disease is more common in the male than in the female sex.

Anatomical Changes. With rare exceptions only one side of the brain is the seat of the hemorrhage. The extravasated blood tears up the brain tissue and forms a clot. Occasionally the effused blood bursts into a ventricle or escapes to the surface of the brain. As a rule, only one clot occupies the brain, but two and even three recent clots, or a clot of an older date, may be found on post mortem examination. Clots are of various sizes. They may not exceed the size of a pea or be as large as a man's fist. Very large extravasations flatten the convolutions and thereby increase the volume of the affected hemisphere.

A recent clot presents the appearance of a dark, pitchy mass, which is composed of the effused blood and the debris of the destroyed brain tissue. The contiguous substance of the brain is infiltrated with the blood and is softened. The edges of the cavity in which the clot lodges are jagged and irregular.

The clot itself undergoes certain changes. It assumes a brownish or saffron tint and gradually becomes absorbed. New connective tissue, which develops around the clot, organizes and forms a cyst. This cyst is frequently found to contain an ochre-colored fluid, and sometimes in old standing cases it is replaced by cicatrical tissue of a rusty color.

Clinical History; Premonitory Symptoms. A person is said to be threatened with apoplexy when certain symptoms or "warnings" make their appearance. These so-called premonitory symptoms are identical in character with those which are ascribed to cerebral hyperæmia, to which the reader is referred. But it is a matter of common experience that in numerous instances of apoplexy from cerebral hemorrhage none of these alleged prodromic signs are noticed. Greater significance must be attached, in estimating the liability to cerebral hemorrhage, to the existence of heart or kidney trouble.

The Apoplectic Seizure. A very copious extravasation, especially when the blood is poured out suddenly or breaks into a ventricle, or if the rupture happens in the pons, the cerebellum or the medulla oblongata, is immediately followed by profound coma, and the patient falls down as if struck by lightning. But this is not the usual mode of onset. Cerebral apoplexy is far more frequently ushered in by headache, vertigo, confusion of thought, sickness of stomach and a sensation of faintness. When the seizure comes on

during sleep, which is of common occurrence, the patient, on waking up in the morning, finds himself paralyzed. There are many cases of cerebral hemorrhage in which the apoplectic condition is absent, or is of such a slight character as to attract little notice. Hemiparesis may be the first and only sign of a clot in the brain. Sometimes immediately before the seizure sets in, the mind wanders, speech is incoherent, or nausea and vomiting take place, or an arm or a leg becomes slightly paralyzed. Now and then general convulsions precede an attack.

The Accessory Symptoms. Stertor always indicates implication of the center of respiration, but it is not a constant symptom of cerebral apoplexy. The pulse, the temperature, and the state of the pupils may be perfectly normal throughout the attack, or they may show alterations. All of these subordinate symptoms are more of a prognostic than diagnostic value.

Termination of the Apoplectic Condition. In the greater number of cases of cerebral apoplexy, the consciousness is restored after a shorter or longer time, hardly exceeding three hours at the utmost. Occasionally the comatose condition merely amounts to a brief fainting fit. Death is imminent if the unconsciousness be protracted beyond forty-eight hours. A fatal termination of cerebral apoplexy is seldom witnessed in less than fifteen to thirty minutes from the time of the beginning of the coma.

Inflammatory Reaction. If the patient in the course of a few days again falls into a stupor and becomes feverish, restless and delirious, it must be inferred that an inflammatory reaction has involved the brain tissue in the immediate neighborhood of the clot; these symptoms, however, are moderate and disappear quickly.

The Paralysis. As soon as the patient has rallied from the immediate effects of the hemorrhage, *i. e.* when the apoplectic condition has passed off, the evidence of the permanent mischief done to the brain becomes manifest. This consists of paralysis affecting the side of the body opposite to that of the lesion in the brain. The hemiplegia involves the muscles of one half of the face and the arm and leg of the same side. The intensity of the paralysis varies from slight muscular weakness to absolute loss of motion.

Anæsthesia. The cutaneous sensibility of the paralyzed side remains, as a rule, intact, but the anæsthesia in exceptional cases is sometimes well-marked and persistent.

Course of the Paralysis. With the advent of the paralysis the chronic stage of cerebral hemorrhage may be said to have commenced. Spontaneous improvement of motility up to a certain point is the usual course, and even complete restoration of the muscular power may eventually take place. But such a fortunate termination is rarely witnessed. The facial paralysis in most cases is limited to the muscles of the lower part of the face, and often disappears at an early date. Improvement of the paralysis of the limbs is first noticeable in the leg. Many patients are again able to walk long before they have much use of the arm. Sometimes one of the limbs or both become stiff soon after the attack. This "early rigidity" is of short duration. Contractures of the extremities which develop at a late period remain permanent. The intelligence and memory deteriorate when the extravasation has been large. There is no diminution or alteration of the electric excitability of the paralyzed muscles, at least for a considerable period. The faradic muscular contractility in old cases is not seldom diminished.

Localization of the Hemorrhage; Corpus Striatum. Hemiplegia is typical of lesions of the striated body. In fact, this motor ganglion, including the lenticular nucleus, is the most frequent seat of cerebral hemorrhage.

Thalamus Opticus. This central ganglion is often implicated in hemorrhage of the corpus striatum. It is doubtful whether a lesion exclusively confined to the thalamus induces paralysis.

Pons Varolii. Profuse hemorrhage into this organ proves speedily fatal. Profound coma at once sets in, or death is immediately preceded by epileptiform convulsions. The "pin's head" contraction of the pupils is frequently so well marked in effusions into the pons, that this symptom may give rise to suspicion of opium poisoning. Clots in the pons, according to their size and position, cause different forms of paralysis: 1. Hemiplegia of the ordinary type, affecting the extremities and the face on the side opposite to the lesion. 2. Alternate paralysis; the extremities on the side opposite to the clot and the face on the same side of the clot being paralyzed. 3. In rare instances the paralysis is limited to the hypoglossal or facial nerve.

Cerebral Peduncles. Injury to these bodies usually occurs in connection with hemorrhage of neighboring parts. The characteristic

feature of circumscribed lesion of one of the crura is total paralysis of the extremities on the opposite side, and paralysis of the motor oculi nerve on the side of the lesion (a cross-alternate paralysis).

Medulla Oblongata. Hemorrhage affecting this important part of the brain rarely occurs. It usually causes instantaneous death.

Lateral Ventricles. Speedy death, preceded by deep coma, is the uniform result of extravasation into these cavities. It may happen when the blood comes from the striated body, or the thalamus opticus, that the patient emerges for a short period from the apoplectic condition, but as the ventricle fills with blood the coma returns with fatal result.

Cerebellum. Hemiplegia associated with the symptoms of incoordinate or "forced" movements, deviation of the eyes and vomiting, suggests hemorrhage of the cerebellum.

Cerebral Lobes. Hemorrhage occurring in the medullary substance of the cerebral lobes may or may not produce symptoms. Hemiplegia of the ordinary type sometimes results from such a lesion. The paralysis is attended by psychical disturbances if the cortex is implicated.

Diagnosis. The differential diagnosis between cerebral hemorrhage and softening of the brain will be discussed in connection with thrombosis and embolism of cerebral arteries.

Apoplexy followed by paralysis offers the least difficulty to diagnosis, for whatever may have been the mode of onset, if paralysis of the hemiplegic order exists, there must be some brain lesion. But in cases of rapid death in the apoplectic condition—say in the course of half an hour, or even less time, the recognition of the true state of affairs is not so easy. Cerebral hemorrhage, as a rule, does not kill in such a short time. It is far more likely that the fatal result depended either on meningeal hemorrhage, the rupture of an aneurism, or failure of the heart's action from valvular disease or fatty degeneration of this organ.

The most embarrassing cases, however, are those in which persons are found in a state of coma resembling cerebral apoplexy, of whose previous history nothing is known. Suppose a man, deeply comatose, is picked up in the street by a policeman, or a stranger at a hotel is found in a stupor from which he cannot be roused, it would be hazardous to express an opinion concerning the true condition of

these patients. If such persons are advanced in years, if the superficial arteries are tortuous and rigid, or the signs of renal or cardiac disease can be made out, then there is great probability that the loss of consciousness is either the effect of cerebral hemorrhage or of acute softening of the brain. Still, this does not exclude the possibility of injury to the head, deep intoxication, opium poisoning, uræmia or epileptic stupor. Generally a due consideration of all the diagnostic points in reference to these several morbid conditions will remove the doubt, through it is best to be guarded in expressing a hasty judgment. It has often happened that the extreme prostration presented by a drunken man has induced compassionate people to ply him with brandy, and contrariwise a man with a clot in his brain has sometimes been arrested by the police on the charge of drunkenness.

Prognosis. Whether a patient who is down with apoplexy will come out of it or not depends upon the mildness or gravity of the symptoms, or rather upon the quantity and localization of the extravasated blood. If the coma be not profound and the insensibility incomplete, if there is little or no stertor and the pulse and temperature keep within normal limits, the patient will in all probability come out of his apoplexy. The case is unpromising if the coma is deep and persistent, if there is marked stertor, slow and shallow breathing, a retarded or irregular pulse and sinking of the body temperature. The chances whether a person who safely got over an attack of cerebral apoplexy will have another one are much against him if his arteries are diseased or his heart or kidneys are affected.

Treatment. The routine practice of venesection in every case of cerebral apoplexy is now generally abandoned, and for good reasons. Numerous patients promptly recover from apoplexy for whom nothing is done in the way of treatment. It is hardly reasonable to suppose that a few ounces of blood, more or less, in the general system can exercise any influence in arresting the extravasation from a ruptured bloodvessel. The use of derivatives and cold applications to the head for the same purpose rests upon equally irrational grounds. There are, nevertheless, exceptional cases in which benefit may be expected from bloodletting, though it requires much tact and judgment to recognize them. The following symptoms are said to indicate abstraction of blood: a cyanotic appearance of the face, a

hot head, suffused eyes, a vigorous pulse and a labored respiration. Even under these circumstances, especially in old people, it is advisable to be contented with the effects of a few drops of croton oil placed on the tongue, or stimulant enemata.

An opposite plan of treatment is indicated when there is pallor of the face, the temperature low, the pulse feeble and irregular, the respiration slow and shallow, and the pupils widely dilated. Patients in this condition are in danger of sinking rapidly. Wine, brandy, ether, musk and camphor must be steadily given in large doses to prevent fatal collapse. Should a patient be unable to swallow, it is necessary to administer the ether or whiskey with the hypodermic syringe. The failing respiration may be excited by dashing cold water on the face and the bare chest; the skin should be briskly rubbed and sinapisms be applied to the insides of the arms and legs.

It is sufficient, in ordinary cases of cerebral apoplexy, to place the patient in a comfortable position, to raise the head and shoulders, and to keep off all disturbances.

The ice-bag must be applied to the head and an active purgative ordered, if the inflammatory reaction runs high. Pain in the head is frequently relieved by a blister on the nape of the neck.

Formerly a great variety of remedies were employed with the object of promoting the absorption of the extravasated blood. At the present day the futility of meddling with the clot is well understood. Confidence in the recuperative powers of nature to restore, in some measure, the damage which has been inflicted on the brain, is fully justified by the improvement of the paralysis which gradually goes on.

Much can be done to prevent or retard a renewal of the hemorrhage by measures which invigorate the general system. Patients should be advised to abstain from physical strains and mental overwork.

Infantile hemiplegia results from hemorrhage, embolism, tumor, or from meningo-encephalitis of the cortical motor zone. The paralysis sometimes develops during the convalescence from diphtheria, typhoid fever, scarlatina and other acute febrile diseases. From the hemiplegia in the adult it is distinguished by the arrest of growth of the bones, especially of the upper extremity. Orthopedic measures, assisted by the use of electricity, must be employed to prevent atrophy and deformity of the paralyzed limbs.

Softening of the Brain. Cerebral Embolism and Thrombosis.

Since Virchow's important investigations on embolism and thrombosis, it is now generally conceded that softening of the brain, in the majority of cases, is due to occlusion of small cerebral arteries. Thrombosis of cerebral arteries develops in the same manner as it does in other arteries. It either starts from an inflammatory process, or a degenerative change which affects the vascular walls and finally obstructs their lumen. The emboli which plug up cerebral arteries are generally derived from warty excrescences, or so-called fibrous vegetations, that form on the valves of the heart after attacks of endocarditis. Another source of these emboli is contributed by concretions of the internal lining of the heart and the aorta. They consist much less frequently of detached particles of cancerous, tubercular, or puriform matter. Minute portions from a broken up thrombus in the brain may likewise give rise to cerebral embolism.

The middle cerebral artery being the direct continuation of the internal carotid is particularly liable to embolic obstructions, and, as its branches do not freely anastomose with arteries from other sources, the collateral circulation fails to be established when they are plugged. Hence the central ganglia and adjacent parts of the brain which are nourished by these "terminal branches" are predisposed to softening. The reason why cerebral embolism occurs more frequently in young persons than in the old, is owing to the circumstance that the former are prone to suffer from rheumatic endocarditis and its consequences.

Anatomical Changes. The first effect of cerebral embolism is anæmia of that limited area of the brain which is cut off from the supply of arterial blood. Sometimes the affected brain tissue breaks down at once and softens; but this may be preceded by stagnation of the blood in the veins and capillaries. Examined by the microscope, it is found that the altered brain substance has undergone destructive changes. Its nerve elements have degenerated and appear surrounded by an abundance of compound granule corpuscles. The diseased brain tissue is finally transformed into a semi-fluid mass, consisting of disintegrated nerve cells and fibres.

Clinical History. An apoplectiform attack is sometimes the first intimation of the occurrence of cerebral embolism in persons whose general state of health had heretofore appeared to be satisfactory. The loss of consciousness is then as complete and comes on as suddenly

as in the case of cerebral hemorrhage. Acute softening of the brain is, however, more commonly ushered in by convulsions, delirium or sickness of stomach. On close inquiry it will often be found that patients had previously presented evidences of failing health. Usually they are men advanced in life or who had shown signs of premature senile decay. Symptoms of deterioration of the mental and physical powers may have been noticed for weeks or months before the final break-down. Many of these symptoms have the character of "warnings," though it is perhaps more correct to consider them part and parcel of the attack itself. Thus there is more or less headache, vertigo and faintness, unsteadiness of gait, a tendency of the body to lean to one side, sensations of numbness and formication in the limbs, incoherence of speech, misplacement of words and a feeble memory.

The coma is usually less profound than it is observed in the cerebral apoplexy from hemorrhage. Patients can often be roused for a short time and they may even answer questions, but soon fall back again into the former dazed condition.

The paralysis is always of the hemiplegic type, and on the side opposite to the lesion in the brain. It may be as complete as in hemorrhage, but more frequently it is partial.

Psychical disorder is very common. The alteration may display itself by an unwarranted irritability of temper, childish wilfulness, outbreaks of unprovoked anger, or a disposition to manifest emotional excitement without an evident cause. Patients in this condition are easily controlled in their actions by outside influences. They exhibit some degree of mental imbecility even when they are at their best.

Aphasia. This highly interesting phenomenon, which is discussed in a former chapter, is often witnessed in occlusion of cerebral arteries. In nearly all of the published cases, the softening had involved Broca's convolution, or the Island of Reil and adjacent portions of the parietal lobe of the left hemisphere.

Diagnosis. However difficult and sometimes impossible it may be to make the distinction between the clinical history of softening and that of hemorrhage, there are certain considerations which serve to turn the balance in favor of one or the other. 1. The apoplectic condition in softening is frequently not well marked. It may amount to no more than a transitory sensation of faintness or confusion of mind. Such is seldom the character of the apoplectic attack in

hemorrhage. 2. Mental disturbances, as a rule, are either absent or soon pass over in hemorrhage, while in softening they are very common and usually persistent. 3. The paralysis in hemorrhage is nearly always complete at first, while in softening it is more commonly incomplete and partial. 4. A hemiplegia which disappears in a few days cannot be due to a clot. It is far more probable that the paralysis in the case resulted from an embolus, and passed off as soon as the collateral circulation had been completely established.

Sometimes it is possible to tell whether the softening depends upon an embolus or a thrombus. The suddenness of the apoplectic seizure speaks in favor of the former, the more so if the patient is a young person.

Prognosis. Although patients frequently recover from the immediate effects of the occlusion of cerebral arteries, they are liable to its recurrence in other parts of the brain. Even if they remain exempt from a repetition of attacks, they enter upon the stage of chronic softening, which necessarily yields a very bad prognosis.

Treatment. If it were possible in a case of apoplexy to determine with certainty the existence of cerebral embolism, efforts might be made by means of tonics and stimulants to restore the circulation. But it involves, certainly, a great risk to administer brandy on the supposition that an artery has become plugged, whilst it is just as probable that hemorrhage is going on. Beyond good nursing and paying attention to the secretions hardly anything can be done. The restlessness and nocturnal delirium of old paralytics yield more readily to small quantities of a generous wine than to anodynes. Some benefit may be expected from the syrup of iodide of iron, or the syrup of lacto-phosphate of lime and iron.

Cerebral Tumors.

A great variety of adventitious growths affect the brain and meninges. Their morbid anatomy is identical with similar neoplasms that occur in other parts of the body. A brief description of some of the more important varieties of brain tumor is, therefore, all that is necessary.

The Glioma is a hyperplastic growth of the connective tissue of the brain, variable in size, of a greyish or greyish red color, and sometimes extremely vascular, so as to give rise to hemorrhage. It usually develops in the medullary substance of the brain.

Sarcomatous Tumors indiscriminately invade different regions of the brain. They are frequently adherent to the meninges, where they give rise to circumscribed inflammation and softening of the brain tissue. Sometimes they remain dormant for a long period.

Tubercle. The favorite seat of tubercle in the brain is the cerebellum, and next in frequency, the hemispheres. It occasionally attains to the size of a hen's egg. It is more frequently encountered in children than in adults.

Cancer is the most common species of intercranial tumors. The malignant growth is usually of the medullary kind. As a rule it is a primary cancer and occurs isolated. Multiple carcinomata develop in symmetrical parts of the brain. The largest cancerous tumors found in the brain start from the orbit and the skull.

Among the less common forms of cerebral tumors belong aneurism, osseous and cystic growths, hydatids and cysticerci.

Clinical History. It is a singular fact that a cerebral tumor may give rise to no symptoms. This latency is probably due to the particular seat of the morbid growth or to the absence of changes in its composition.

Headache constitutes the most conspicuous and constant symptom of brain tumors. The pain is generally very severe. At first it comes on in paroxysms, but later it is continuous. There is no uniform relation between the seat of the pain and that of the tumor. When the trigeminal nerve becomes implicated it gives rise to a violent form of facial neuralgia.

Vertigo is invariably associated with the headache. This symptom is sometimes so aggravated that patients stagger and reel as if they were drunk.

For a considerable period nothing else is complained of but the headache and dizziness. By-and-bye new sets of symptoms of great significance make their appearance.

Epileptiform convulsions seldom fail to occur during the course of a brain tumor. They cannot be distinguished from true epileptic fits if no concomitant symptoms point to the existence of a gross brain lesion. The real nature of these convulsive seizures is more readily recognized when they are limited to one side of the body, or when they are succeeded by paralysis. Slighter motor disturbances of an irritative character are observed at an earlier date, consisting of tonic or clonic spasms of isolated muscles or groups of muscles. Twitching

of facial muscles is quite common. The limbs are less frequently affected by cramps and stiffness. Choreic movements are occasionally witnessed on one side of the body.

After a longer or shorter period, paralysis or paresis of the hemiplegic type supervenes. Paraplegia occurs when the tumor involves both hemispheres. Very frequently there is only one-sided paralysis of the facial or ocular muscles.

Disorders of sight are exceedingly common, from slight dimness of vision to total blindness. The ophthalmoscope gives important information concerning the diseased condition of the optic nerve and the retina. The principal changes consist of intra-ocular pressure, optic neuritis, and, finally, atrophy of the optic nerve.

The auditory nerve is frequently implicated, giving rise to defective hearing, noises in the ear, or complete deafness.

Nausea and vomiting constitute occasionally such prominent and persistent symptoms as to mask the real nature of the disease. These gastric disturbances are nearly always accompanied by headache and vertigo.

A perturbed state of the mind is observed in many cases of brain tumor. Maniacal excitement is rare, but hallucinations often exist. At a later period somnolence and apathy develop, attended by embarrassment of speech, ending in imbecility. At this stage, apoplectiform attacks are liable to occur; the epileptiform paroxysms increase in frequency and the paralysis progresses or becomes more intense. Finally, the automatic centers of respiration and circulation suffer, and fatal coma closes the scene.

Diagnosis. The indefiniteness of the initial symptoms in many cases of cerebral tumor renders diagnosis a difficult task. Even in apparently well-marked cases much care is required not to confound them with allied brain affections. The differential diagnosis mainly turns upon the distinction from cerebral abscess and cerebral syphilis.

Localization of Cerebral Tumors. It is hardly necessary to go over the diagnostic points in reference to the localization of brain tumors, as this would amount in a great measure to a repetition of what has been said respecting the localization of cerebral hemorrhage.

Neoplasms of the brain, as Hughling Jackson expresses it, cause "discharging lesions" and not "destroying lesions." Hence the diffused nature of the morbid influence which they exercise enhances the difficulty of localizing them.

Prognosis. All intracranial tumors, irrespective of their character, tend to a fatal termination. Death is sometimes postponed for years, and occasionally the symptoms improve, but the pain which no treatment can relieve, the loss of sleep, the nausea and vomiting exhaust the patient at last, even if the epileptoid and apoplectiform attacks do not more speedily bring about the end.

Treatment. This is entirely symptomatic. Anodynes for the relief of the pain are indispensable. The bromides exert some control over the convulsive paroxysms. Alcoholic stimulants, tea and coffee should be strictly prohibited. Since it is now known that injuries to the head may lay the foundation of brain tumors, prophylactic measures should not be neglected even in slight injuries.

Cerebral Abscess.

Diffuse encephalitis has never been known to occur. In the circumscribed softening of the brain, due to embolism, inflammation plays no part, but true inflammatory softening is sometimes found in the immediate vicinity of a blood clot and tumor. Cerebral inflammation of a limited extent is recognized by a collection of pus mixed with the detritus of the destroyed brain tissue. It is, therefore, more proper to speak of cerebral abscess.

Acute Cerebral Abscesses arise from injuries to the head from contusion, as well as from fracture and penetrating wounds of the skull.

Internal otitis is another source of abscess. It usually develops suddenly after a patient has suffered for a long time from a running ear. The inflammation involves the temporal bone, creeps inward toward the cavity of the cranium and sets up a suppurative meningitis. In general, it may be said that the symptoms of acute cerebral abscess present the characters of traumatic meningitis.

In persons who are affected with caries or necrosis of the cranial or nasal bones there is a tendency to the formation of pyæmic abscesses within the brain.

A cerebral abscess may merely present the appearance of a small spot of softening. Multiple abscesses are generally small in size. If there is only one abscess it is commonly large. The greater part of one hemisphere is sometimes transformed into an abscess.

Chronic Cerebral Abscess. A cerebral abscess of old date is invariably found encapsulated. The cyst-wall is formed of fibro-cellular tissue. Its inner layer is composed of a smooth pyogenic membrane. The pus it contains is of a greenish or greenish yellow color, of a fetid smell and alkaline reaction.

The brain substance contiguous to the abscess shows yellow softening.

Clinical History. Pain in the head, first of a remittent and then of a continuous character, may be the only sign of the disease for a lengthy period. Sometimes the occurrence of an abscess is announced by convulsive fits, or one side gradually becomes paralyzed. Rigors of a regular intermittent type, or immoderate attacks of vomiting, may completely mask the nature of the disease, until the occurrence of epileptiform paroxysms, paralysis and coma clear up the case. Frequently it can only be said that the patient suffers from some serious brain troubles without being able to give a more decided opinion. There are cases of cerebral abscess which so greatly simulate typhoid fever that the true state of affairs is only revealed by the post-mortem appearances.

Diagnosis and Prognosis. The main reliance in judging of the existence or non-existence of cerebral abscess rests on the results of a careful examination. In fact, the diagnosis hinges either upon the history of some injury to the head, chronic discharge from the ear, or a source of pyæmia. Idiopathic cerebral abscess may be fairly excluded. A fatal termination appears to be the inevitable result of the disease.

Treatment. Preventive measures are urgently called for in affections of the ear and nose that may possibly give rise to cerebral abscess. The prime indication in these cases is to give a prompt vent to the discharges. Palliative remedies constitute the only resource in the established disease. Leeches and cold applications to the head in acute, and opium in chronic, abscess prove occasionally of benefit. A simple diet and a quiet life may succeed in rendering the abscess dormant for an indefinite period.

Cerebral Syphilis.

When syphilis involves the substance of the brain, it is after a considerable lapse of time subsequent to the primary affection.

Usually the implication of the nervous system takes place after the outward signs of the constitutional disease have disappeared.

It is important at the outset to consider the effects of the venereal disease on the bones of the skull. The inner table of the cranium is subject to syphilitic disease, resulting in caries and necrosis. At the base it gives rise to periostitis and exostosis, which compress the cranial nerves as they pass out through narrow bony canals. These pathological changes favor the development of pachymeningitis and basilar meningitis.

The Syphiloma or gummy tumor constitutes the most frequent and important specific lesion within the cranium. As a rule, gummata develop in the meninges and more rarely in the bones of the skull. Two varieties are recognized, although they are often united. The one consists of a soft greyish mass, irregular in shape and blending with the surrounding healthy tissue. The other is a firm, cheesy substance of a yellowish color, and forms a circumscribed tumor. Microscopical examination of the soft syphilitic infiltration shows that it is composed of numerous round cells and nuclei, and an abundance of bloodvessels. These elements are gathered within alveoli and form ill-defined nodules. The dense gummy tumors consist of a dry, granular mass resembling caseous matter.

The favorite situations of these growths are the dura mater and the subarachnoid spaces. They seldom originate in the substance of the brain, but cause softening of the cortex by the pressure they exert on the convexity. Occasionally the optic nerve and the interior of the brain are found involved in the specific degeneration and atrophy.

Great importance attaches to the specific changes which the walls of the cerebral arteries undergo. The branches of the middle cerebral and of the basilar artery are particularly liable to syphilitic disease. Their walls become opaque and gradually assume a white color, this change being due to a new growth which renders them rigid, so that finally they acquire an almost cartilaginous hardness. The calibre of the affected bloodvessels is thereby narrowed, and in some places becomes occluded by the formation of thrombi and emboli. In consequence of this obstruction, limited areas of the brain deprived of arterial blood break down and soften. Sometimes the brittle condition of an artery causes it to give way under the blood pressure, and hemorrhage follows.

Clinical History. Precursory symptoms of variable intensity, and little characteristic of a specific causation, frequently make their appearance prior to the development of the more grave symptoms of cerebral syphilis. They principally comprise headache, dizziness, insomnia, vague neuralgic pains, and some impairment of the intelligence. Not seldom the first intimation that the specific disease has involved the nerve-centers is the sudden occurrence of convulsive seizures indistinguishable from epileptic paroxysms or some form of paralysis. Sometimes an apoplectiform attack or a fit of temporary insanity ushers in the involvement of the nervous system.

Paralysis takes the lead in the frequency of the symptoms that attend syphilis of the brain. It assumes a variety of forms. Hemiplegia may either precede or follow an apoplectic seizure. It has been observed to occur in one-third of the cases of cerebral syphilis. The more unusual forms of paralysis are paraplegia, alternate paralysis, paralysis of unsymmetrical muscles, multiple and isolated paralysis. The cranial nerves seem to be especially prone to syphilitic paralysis. First come the motor oculi. Ptosis has acquired for this reason the notoriety of being a sure sign of syphilis. The facial nerve comes next in the order of frequency, and the sixth is, perhaps, quite as often affected, causing internal strabismus. Isolated paralysis of the tongue points to the implication of the hypoglossal nerve. Aphasia commonly attends paralysis of the right half of the body.

A remarkable feature, peculiar to these paralytic disorders, is their fragmentary, irregular and changeable character. Sometimes one cranial nerve recovers its function, then another is attacked, and even the more formidable symptoms of cerebral syphilis disappear occasionally with surprising rapidity. In explanation of the simultaneous and successive implication of cranial nerves, it may be fairly supposed that the syphilitic exudation at the base of the brain involves now one then another or more of the nerve trunks. Since it has been ascertained that syphilitic disease of the brain affects the vascular walls, there is no great difficulty to account for the singular fluctuation of syphilitic brain symptoms, on the supposition that the specific alteration retrogrades in one part of the brain and implicates in turn another. In the case of the apoplectiform attacks which sometimes rapidly pass over without leaving a trace behind, there is reason to believe that the effects of embolism wore off as soon as the obstructed circulation had been compensated by neighboring vascular districts.

Sensory disturbances play a subordinate role in cerebral syphilis. Violent and constant headache sometimes precedes the more grave brain symptoms, but this pain in the head should not be confounded with the pain from nodes and periostitis affecting the outside of the skull.

One of the most serious effects of cerebral syphilis is disturbance of the visual organs. Sight may be quickly abolished if this result be not promptly prevented by appropriate treatment. This complication begins with ordinary weakness of the eyes. Total blindness results from the development of optic neuritis, which the ophthalmoscope readily detects.

Syphilitic insanity presents no distinctive features. Sometimes all the characteristic symptoms of the general paralysis of the insane have been observed.

Diagnosis. The chief dependence in the diagnosis of cerebral syphilis must be based on the previous history and present condition of the patient. An accurate examination is all the more necessary in view of the fact that the invasion of the nervous system usually occurs at a late date, when but few or none of the significant marks of the constitutional disease are present. Particular regard must be had to the order of occurrence of the symptoms, their peculiar grouping, the isolated forms and irregular combinations of the paralytic disorders. It is rare to encounter the unusual sequence and assemblage of symptoms characteristic of cerebral syphilis, in ordinary gross lesions of the brain.

Prognosis. Of all the serious affections of the nervous system, those of a syphilitic origin afford the most favorable prognosis, especially if the anatomical changes are of recent date, and the specific treatment is followed up with promptness and perseverance. Permanent and destructive lesions of the nerve centers owing to the devastations of the venereal poison, are as little amenable to therapeutics as those of a different nature. Even under these unfavorable circumstances some degree of improvement is occasionally attainable.

Treatment. The only question that can arise in relation to the treatment of cerebral syphilis refers to the choice of the specific remedies—mercury or potassium iodide. There is a general agreement among observers that mercury is preferable when the appearance of grave brain symptoms calls for prompt and energetic action. In case of irritability of the stomach, it is advisable to resort to the

hypodermic introduction of corrosive sublimate. Mercurial inunction for the same purpose is better adapted to hospital than private practice. Large doses of the potassium iodide can sometimes be given with greater advantage than mercury.

Labio-Glosso-Pharyngeal Paralysis (Bulbar Paralysis).

A form of paralysis is now recognized which affects the lips, the tongue, the pharynx and larynx, and eventually causes disturbance of deglutition and respiration. This complexity of symptoms is attributed to a lesion which involves the nuclei of nerves that arise from the medulla oblongata. Duchenne, who led the way in pointing out the peculiar clinical features of this disease, gave it the above name. "Bulbar paralysis" is, however, a more convenient designation.

Anatomical Changes. The roots of cranial nerves situated in the floor of the fourth ventricle are found in a state of atrophy. This lesion affects, in the order of frequency, the roots of the hypoglossus, the spinal accessory, the pneumogastric, the facial and the external motor oculi. The roots of the glosso-pharyngeus, the acoustic, and trigeminus are seldom involved. Many of the ganglionic cells of the degenerated nuclei have disappeared, and those that remain are shrivelled and filled with pigment and granular matter. The ganglionic cells of the anterior horns, in many parts of the cord, participate in the atrophic degeneration. In the majority of cases, the neuroglia and bloodvessels in the floor of the fourth ventricle are involved in a sclerotic process, which takes an ascending or a descending direction, and secondarily affects the nerve elements. The paralyzed muscles are of a pale color, infiltrated with fat of soft consistence and subject to fibrillary twitchings. They retain their electric excitability.

Etiology. No special cause of the disease is known. It affects persons in all classes of society. The greatest number of cases occur in the male sex between the ages of forty and seventy years. Heredity does not appear to exert a predisposing influence.

Clinical History. The paralytic symptoms develop insidiously. At the begininng of the disease there is merely a slight impediment of speech and an oppressive feeling in front of the neck, to which the patient pays but little attention. Gradually the heaviness of the

tongue increases, and the acts of speaking and eating require unusual efforts. It is now observed that certain consonants are pronounced in an indistinct manner. By-and-bye the letters R and Sh cease to be articulated; then follow S, L, K, G and T, and later D and N. When the lips begin to share in the paralysis, the articulation of the vowels O and U, and the labials B, P and M, becomes impossible. The vowels A and E can be pronounced to the last, though a final stage is reached when the miserable patient is only able to emit a grunt.

Immobility of the tongue also interferes with mastication, and for the same reason the food cannot be sufficiently carried backward to the pharynx. Deglutition becomes, therefore, a difficult task, which the patient assists by pushing the food beyond the root of the tongue with his fingers. To this is sometimes added a paralytic condition of the muscles of the soft palate and the uvula, that allows the regurgitation of fluids through the nose or their entrance into the larynx. Other muscles supplied by the facial nerve are rarely affected.

The constant flow of saliva, which trickles over the lips and chin, is an annoying symptom resulting from paralysis of the orbicularis oris. Patients continually apply the handkerchief to the mouth to catch the secretion. The food frequently drops from the mouth, which is partly owing to the imperfect closure of the lips, and partly to the feeble action of the tongue.

Implication of the spinal accessory nerve is indicated by disturbances of phonation. In consequence of defective closure of the vocal cords the voice becomes feeble and finally reduced to a whisper. During the act of swallowing, morsels of food find their way into the open larynx.

At an advanced period of the disease it is not uncommon to witness attacks of dyspnoea and fainting fits. These symptoms show that the pneumogastric nerve has become involved.

In addition to the characteristic symptoms of the disease there are a few others which require a brief notice.

The signs of bulbar paralysis are occasionally preceded by apoplectic or epileptic attacks.

A painful sensation of weight and tension in the nape of the neck and occiput is often associated with a similar affection of the tongue.

Atrophy of the muscles of the neck becomes apparent when the disease has reached its height. The movements of the head are thereby not only rendered unsteady, but the patient finds much difficulty in sustaining it in the erect position.

A most noteworthy feature in the history of labio-glosso-pharyngeal paralysis, is the circumstance that few cases of this disease run a protracted course without becoming complicated with progressive muscular atrophy. But the reverse is quite as common. The reason of this frequent association is well expressed by Kussmaul: "Devoid of definite limits, the one type passes into another allied one."

Course and Termination. During the early period of the disease there is nothing in the outer appearance of the patient to cause anxiety. His general health has not suffered. But a time comes when emaciation makes itself apparent, from insufficient supply of food, although the appetite is craving. At last the patient presents a woeful picture of wretchedness. His helplessness is extreme; speech is gone; the desperate efforts to swallow food are futile; the lips are thinned to a degree of transparency; the mouth stands open and the saliva continually dribbles away. The intelligence remains clear, though nothing is left him to convey the sense of his misery but the expression of his eyes.

If some intercurrent disease does not put an end to this pitiable condition, death follows from sheer exhaustion; or the escape of morsels of food into the air passages brings on a fatal broncho-pneumonia.

Diagnosis. In general, the difficulty of diagnosis in spinal affections is due to the complexity of symptoms that blurs their typical character. A hasty judgment may declare for the existence of labio-glosso-pharyngeal paralysis, although some of its clinical features are merely incidental to a disease of a different order. Symptoms of bulbar paralysis have been observed in multiple sclerosis, in obliteration of some of the basal arteries, and in tumors involving the medulla oblongata. But in all such cases the beginning and course of the disease differ in many respects from the clinical history peculiar to labio-glosso-pharyngeal paralysis. The latter is always distinguished by the gradual development of paralysis and atrophy affecting the tongue, lips and pharynx, the disturbances of deglutition and speech, and a frequent combination with progressive muscular atrophy. It would be a serious mistake to confound with bulbar paralysis the salivation, the aphonia, the difficulty of swallowing and disturbance of speech, suddenly occurring in a hysterical female.

In regard to prognosis, Trousseau makes the following sad confession: "I do not believe that a single case of this disease is on record in

which its progress has been arrested even for a few months. From one to three years is the usual duration of the disease."

Treatment. Duchenne and Kussmaul observed temporary improvement of speech and deglutition from faradization of the palate and tongue. Galvanization of the sympathetic is recommended by others. The symptomatic treatment has mainly for its object the feeding of the patient. This may require the use of the œsophageal tube. Attacks of suffocation that endanger life must be relieved by tracheotomy.

CHAPTER XII.

THE CLASSICAL NEUROSES.

Epilepsy.

The essential symptom of epilepsy consists of a recurrence of convulsive seizures attended by loss of consciousness. This phenomenon, however striking and formidable looking as it is, would not alone vindicate for epilepsy the rank of a substantive disease, as spasmodic paroxysms result from a variety of pathological conditions. The peculiarity of epilepsy relates to an inexplicable tendency of certain nerve centers to be thrown into a state of excitement at irregular periods and without an assignable cause, giving rise to a typical form of convulsions in individuals who, although they suffered from these life-long attacks, nevertheless show no palpable distinctive lesion of the nervous system on post-mortem examination.

Clinical History. Grand Mal. Some epileptics utter a frightful scream or yell at the onset of an attack. In the greater proportion of cases the patient falls suddenly to the ground without warning or making an outcry. The loss of consciousness and of sensibility is complete. The limbs become stiff and fixed, the eyeballs deviate to one side, the head rotates in the same direction, the face is pallid and the features are distorted. Tonic contractions of the chest and abdomen quickly supervene which interfere with the act of respiration, causing lividity of the countenance. The pupils are dilated and the conjunctivæ insensitive. This tetanic condition soon changes into muscular tremors, followed by clonic spasms that violently jerk the head, limbs and trunk. This stage may last from ten to forty seconds.

During the second stage the coma persists and is profound. The clonic contractions become general, though occasionally they are more marked on one side than on the other. Respiration is extremely embarrassed; the thoracic walls and the diaphragm move convulsively; the alæ nasi stand widely open; a gurgling noise proceeds from the trachea; mucus collects in the throat and appears as bloody froth at

the mouth; the tongue is bitten by champing of the jaws; the eyes roll in every direction; the bloated face looks livid or dusky; the veins of the neck are turgid; the carotids throb; the heart's action is tumultuous and the pulse is small. Sometimes the urinary and intestinal evacuations are involuntarily discharged and the semen is ejaculated. This stage continues from one to ten minutes.

After the subsidence of the convulsive movements, complete relaxation of all the muscles takes place. Respiration becomes easy, the duskiness of the face disappears, and consciousness is either fully restored or the patient falls into a deep sleep, from which he awakes somewhat confused in mind.

Petit Mal. The principal symptoms of the lighter forms of epilepsy are dizziness, momentary loss of consciousness (which is not always complete), and twitching of some of the muscles. It would be difficult to pronounce with certainty upon the nature of some of these minor attacks were it not for the fact that they often change into the more severe forms, or alternate with them. Patients subject to petit mal not infrequently perform strange acts during this condition of which they retain no recollection. Trousseau relates the case of a judge who, in open court, would leave the bench and answer a call of nature in a corner of the room and then return to his seat in an unconcerned manner. Very little attention is usually paid to these "faints" or "spells," until they occur with great frequency and alarm the patient or his friends.

Precursory Symptoms. Nearly one-half of the cases of epileptic seizures are immediately preceded by vague sensory disturbances or "warnings." These epileptic auræ, as they are called, are of a diversified character. Hughlings Jackson has lately made them the subject of an interesting investigation.

The Epigastric Aura is the most common of all the precursory symptoms. It consists of an uneasy sensation in the region of the stomach, which patients describe as travelling upward and causing a feeling of tightness in the throat. Loss of consciousness immediately ensues. It is highly probable that disturbance of the pneumogastric nerve underlies the different auræ that are felt in the epigastrium, the chest and throat, and occasionally induce nausea, vomiting, a choking sensation, dyspnœa, and violent palpitations of the heart.

The auræ referred to the extremities appear to resemble the sensations of tingling, creeping and numbness. They are frequently

associated with motor disturbances of these parts, and of the face and tongue—such as tremor, twitching of the muscles, and cramp.

Auræ of the special senses are not common. Visual auræ are manifested by dimness of sight, diplopia, total blindness, pain in the eyeballs, flashes of light, colored flames, etc. The auditory auræ consist of hearing of strange sounds and noises.

The cephalic disturbances, headache and vertigo, are not usually attended by other forms of auræ. Some patients experience the sensation as if the head were heavily pressed by a weight or crushed in. An epileptic under my notice always has the sensation of a smart slap on the side of the face immediately before an attack.

Among the psychical auræ, none is more common than an unaccountable terror that seizes the patient. Sometimes they are of a pleasant kind. One of my patients, a young woman who is subject to frequent attacks of grand mal, is occasionally thrown into an ecstatic condition. During one of these morbid mental states she waved her hand as if requesting me to stand aside, and then pointed to a part of the room where she located visions of extended lawns, beautiful flowers, clusters of grapes and wide-spreading trees.

Post-epileptical Condition.

Psychical phenomena are more frequently witnessed in persons who are subject to minor than to severe attacks. Perhaps it is more proper to say that they form a part of petit mal. It is of great importance to recognize the nature of these mental disturbances, for they may be the only manifestations of the disease. In the majority of cases they consist of automatic acts of which the patient is oblivious, although his voluntary power may not be completely in abeyance at the time. Dr. Gowers relates the case of a carman who, after an attack of epilepsy, drove through the most crowded parts of London for an hour, without an accident, and retained no recollection of it afterward. One of my patients, a colored boy, often falls into the hands of the police for exposing his person in the public streets after an epileptic fit.

Epileptic Mania.

Alienists recognize a form of transitory insanity of an epileptic character, during which a person may commit flagrant and criminal acts. Great caution is required in estimating correctly the nature of

this species of alienation. The principal criterion upon which a medical man must rely, in forming his judgment as to the character of the alleged manifestation of insanity, relates to the very short duration of the maniacal paroxysm, the utter want of recollection of what has happened during the state of excitement, and a history of similar attacks. The occurrence of epileptic fits subsequent to the overt act will naturally strengthen the diagnosis of epileptic mania.

Inter-epileptic Condition.

The mental deterioration due to the epileptic diathesis is shown by the large number of persons afflicted with this disease who yearly find their way into insane asylums. According to the statistics reported by Russel Reynolds, only thirty-eight per cent. of his epileptic patients were free from psychical disturbances. Close observers maintain that epileptics whose intellect is apparently not affected, show, nevertheless, some evidences of an abnormal mental state, which is only recognized within the privacy of family life.

The protracted duration of the disease is not the only factor in the mental failure, for in many instances the deterioration is already noticeable at an early date. This impairment of the mind manifests itself at the beginning by defect of memory and incapacity of sustaining intellectual efforts. It ends in complete imbecility. Milder cases are mostly marked by emotional disturbances and unusual fluctuations of the mood and temper, with a tendency to a settled melancholy.

Etiology.

Sex. The predisponent influence of sex is difficult to determine in the face of the discrepancies of statistical inquiries. Whilst French authors find a preponderance of the disease in the female sex, English authors assign it to the male. Echeverria coincides with the latter, which accords with the results of American statistics.

Age. Many cases of epilepsy date their first onset from early infancy. The influence of age is also shown by the frequent development of the malady at the period of puberty.

Heredity. The evidences of a hereditary tendency are decisive, the proportion of cases traced to this cause being about 30 per cent. This figure is undoubtedly below the average, for there is a natural unwillingness on the part of patients and their relatives to give the

desired information. The family history of epileptics often elicits the important fact that some of its members have been affected by allied nervous diseases,—insanity, chorea, intemperance.

Exciting Causes. When speaking of the exciting causes of epilepsy, it must be understood that they are supposed to act upon an unstable nervous system. At the head of these immediate causes stands sudden emotional excitement. A fright in children and nervous females is itself a paroxysm, which, in its visible effects, strongly resembles a convulsive attack. Mental shocks of any kind occurring at the period of adolescence, when the nervous and muscular apparatuses are at any rate inclined to be easily thrown off their balance, exert just such a morbid influence that may at once initiate life-long epilepsy.

Next in order of frequency are injuries to the head, especially falls and blows. The occurrence of a fit from these traumatic causes is not seldom postponed for days and weeks. In cases of this character that gave opportunity for post-mortem examination, no gross lesions were found in the nervous apparatus.

Menstrual disturbances are accused of being connected with the first appearance of fits in very young girls. The expectation that the establishment of the normal flow will put a stop to the fits is not sustained by experience.

Opinions are divided on the question whether epilepsy is unusually common among the intemperate. Echeverria has the following on this mooted point: "On the whole, I deem that the greater prevalence of nervous diseases now observed, acknowledges among the primary agencies the wide-spread abuse of alcoholics." The experience of other observers does not coincide with this statement. In fact, the number of persons affected with epilepsy is insignificant when compared with the number of persons addicted to the immoderate use of alcoholic stimulants.

The same estimate is also applicable to the alleged frequency of masturbation as an exciting cause of epilepsy. It is well known, however, that epileptics are much given to the practice of onanism.

Pathology.

Unimportant anatomical changes affecting the meninges and cerebral bloodvessels are often enough found in long-standing cases of epilepsy, but they are of a secondary character. No significance

attaches to the intracranial venous congestion usually observed in persons who have died during a fit. As a general rule there is an entire absence of gross anatomical lesions in the nerve centers; and thus far the microscope has failed to detect in them any minute histological changes. Induration of the cornu ammonis has recently been found to occur in no inconsiderable number of cases. It is reserved for future investigations to determine what weight is to be given to this morbid alteration. Much has been accomplished of late in the way of experiment to gain an insight into the epileptic phenomena. A satisfactory answer to the two following questions, based upon physiological and pathological data, would, in a great measure, clear up the whole subject of epilepsy: Where is the seat, and what is the mechanism of an epileptic seizure?

There is a general agreement that the seat of the disease is in the grey matter of the brain. The spinal cord acts merely as a conductor. But as regards the particular part of the brain which is the point of departure of the epileptic paroxysm, opinions differ. The majority of English neurologists incline to the view that in most cases it is the cortex of the hemispheres, and only exceptionally the medulla oblongata, which is primarily involved. This view is supposed to be sustained by the consideration that the loss of consciousness being purely a mental symptom, the change must necessarily affect the cortex; and, furthermore, there is no need to conceive of a change taking place in any other nerve center to account for the occurrence of the spasmodic phenomena, since Ferrier has shown that irritation of the motor region of the cortex causes convulsive movements. Clinical observations also point to changes in the cortical centers, for it is an important fact that epileptical seizures are often preceded by psychical symptoms and disturbances of the special senses. This does not exclude the probability that epileptic paroxysms occasionally start from the medulla. Indeed, general convulsions are always propagated by this great reflex center; but this is no proof that this lower nerve center is the primary seat of the disease. Concerning the convulsion, we may readily accept the opinion of Hughlings Jackson, that it is the phenomenon of an occasional discharge of nerve tissue (no doubt of grey matter). It points not to "destroying" lesions, but to unstable nerve tissue—to "functional changes." In reference to the pathological process by which such changes are brought about, he adds "we have no clue." The theory of the unstable equilibrium of grey matter, as Dr. Gowers remarks, adapts

itself beautifully to the explanation of the phenomena of epilepsy. The liberation of energy going on in every nerve cell is a physiological fact. Now, it is not necessary to assume that a convulsive attack implies increase of energy; on the contrary, the existence of the epileptic diathesis rather points in the opposite direction, and this naturally leads to the inference that a want of resistance in the nerve cell—its diminished "inhibitory" power—favors the ready discharge of nerve force.

A theory differing in many respects from the foregoing is principally advocated by German authors. The following synopsis, based on the elaborate statement of Nothnagel, embodies its salient points: Experimental investigations show that convulsive movements resembling those of epilepsy may be produced in animals so long as the pons and the medulla remain uninjured, though every other part of the brain be removed. Spasms of the extremities and of the trunk ensue when the brain alone is irritated. That both of these nerve masses are involved is evident from the fact that the motor nuclei of the nerves situated in the floor of the fourth ventricle are all affected in an epileptic attack. In order to understand the mechanism which arrests the functional activity of the hemispheres during the state of unconsciousness, we must again interrogate the teachings of experiment. Kussmaul and Tenner have shown that the sudden occurrence of cerebral anæmia induces all the symptoms of an epileptic fit. This happens whether the animal be bled to death or a large artery be compressed. Now the pallor of the face and the dilatation of the pupils, observable in many cases of epilepsy, are obviously the signs of cerebral anæmia. This abnormal condition of the intracranial circulation is explicable on the supposition that excitation of the cervical sympathetic ganglia (which contain most of the vaso-motor nerves that go to the cerebral vessels) causes spasmodic constriction of their walls. An observation of Brown-Sequard lends weighty support to this opinion. In guinea-pigs which he had rendered epileptic by his usual method he noticed narrowing of the vessels of the pia during the fits. But it may be asked, if it be granted that cerebral anæmia sufficiently accounts for the comatose condition, how is it with the other phenomenon of the epileptic seizure—the convulsive movements? There is nothing to invalidate the assumption that excitation of both the vaso-motor center and the central motor apparatus constitute coordinate factors of the epileptic paroxysm. Such a view accords well with clinical

facts. There are forms of petit mal in which mental confusion or local spasm is the only symptom. The inference that one of the nerve centers is here exclusively affected can hardly be avoided.

The most important part of the inquiry relates to the nature of the exciting cause which acts upon the "convulsive" center. It may be thought that the "warning" symptoms, which partake of the character of sensory disturbances, initiate an epileptic attack analogous to the effects of a peripheral irritation, which we know may evoke reflex muscular contractions. But it is just as difficult to account for the aura as for the epileptic seizure itself. It is the nature of that morbid excitation which, at regular or irregular periods and in the midst of apparent sound health, induces convulsive paroxysms which still remains inexplicable.

Diagnosis. Considerable care is sometimes required in discriminating between epilepsy and convulsive seizures depending upon organic disease of the brain and blood-poisoning. The minor attacks offer especial difficulties to diagnosis.

Nocturnal epilepsy may exist for years without being suspected by the patient or his family. The signs of the concealed malady are a constant sore tongue, ecchymotic spots on the neck, suffused eyes, and a feeling of languor in the morning. Wetting of the bed is occasionally of similar significance.

No little embarrassment is sometimes felt in estimating the real character of infantile convulsions. When no palpable cause can be assigned for their recurrence, it is well to bear in mind that epilepsy not uncommonly develops at a very early age. Spasmodic seizures due to dentition or resulting from gastric or intestinal derangements, or caused by the passage of a urinary calculus, cease upon the removal of the cause, and are of a longer duration than the convulsions of idiopathic epilepsy.

Diseases of the brain and its membranes, but more particularly intracranial tumors, cerebral abscess, embolism, and syphilis of the nervous system are frequently attended by epileptiform attacks. The distinction from true epilepsy rests upon the clinical history of the case and the consideration of the concomitant symptoms.

Fainting fits bear some resemblance to minor attacks of epilepsy. But syncope can usually be traced to some depressing influence, physical or mental. There is an absence of aura, and the loss of consciousness is not so sudden and complete as in epilepsy.

Vertigo may be mistaken for that form of petit mal which Trousseau calls "vertigenous epilepsy." In ordinary vertigo there is a sense of "falling over," and the patient grasps about for some support; but there is no actual unconsciousness or unforgetfulness of what has happened.

Hysterical Convulsions. No one who has ever witnessed a hysterical fit will confound it with a true epileptic seizure. The tumultuous and not incoordinate movements of the hysterical paroxysms, their protracted duration, the incomplete unconsciousness, the noisy behavior of the patient, and the unchanged appearance of the countenance, contrast strongly with the abrupt onset of epileptic seizure, its short duration, the profound coma, the biting of the tongue, the lividity of the face and the distortion of the features. The real diagnostic difficulty is encountered in those rare instances of "hystero-epilepsy" in which the symptoms are of a complex character. This subject will be more fully considered in its proper place.

Renal Convulsions bear a close resemblance to those of idiopathic epilepsy. The distinction rests on the recognition of the primary disease. It should be remembered, however, that the granular disease of the kidneys which is particularly prone to cause epileptiform spasms, may exist for a long time without revealing its presence by any well-marked symptoms. The urine contains but a moderate amount of albumen, and at times it is altogether absent. An excited state of the heart's action, not depending upon valvular lesion, and the uræmic signs of headache, drowsiness and nausea preceding epileptiform attacks, point to the probable existence of renal disease.

Peripheral Epilepsy. It is of great practical importance to recognize that variety of epilepsy which is due to some peripheral irritation, such as cicatrices, intestinal worms, etc. Cases of this nature promise good results from appropriate treatment.

Simulation. The imitation of epileptic fits by malingerers cannot well deceive any one familiar with the peculiarities of the genuine disease. Impostors cannot produce at will dilatation of the pupils nor insensibility of the conjunctiva.

Prognosis. There is seldom immediate danger to life even in very severe attacks of epilepsy. Death or injury from accidents during a

fit is more to be feared. On the other hand, the prospect of a spontaneous cure is not encouraging. As a general rule it may be stated that the longer the disease has lasted the less chance there is of recovery. Symptomatic epilepsy from organic brain trouble, especially tumors, is absolutely of bad augury. The prognosis is more hopeful when the disease is due to intracranial syphilis. Attacks occurring at long intervals are more amenable to treatment than when they come on after brief intermissions. Minor attacks appear to be less influenced by remedies than the severe forms of epilepsy.

Treatment. The physician, since the introduction of the bromides into the practice, feels less despondent in undertaking the treatment of idiopathic epilepsy than formerly. That these preparations exercise a controlling influence in a large proportion of cases, and occasionally effect a permanent cure, there can be no doubt. Much depends upon the dosage and the persistence in the administration of these drugs. It is best to commence with fifteen or twenty grains of any of the bromides thrice daily, and to gradually increase the dose to 2 drachms per diem. The maximum dose of four drachms in twenty-four hours may be ventured upon in cases of exceptional severity and obstinacy. Small quantities of the bromide suffice so soon as the paroxysms have been arrested for a reasonable time; but on their recurrence, which unfortunately is but too often the case, larger doses must again be given. There is no difference in the therapeutical qualities of the several preparations of the bromides. The potassium bromide answers every purpose. Perhaps the sodium bromide is better suited to delicate stomachs. Brown-Sequard prefers a combination of the ammonia and potassium bromide. Weir Mitchell recommends the bromide of lithium, as it contains the largest percentage of bromine. Nocturnal epilepsy calls for large doses immediately before going to bed.

Belladonna formerly enjoyed a high reputation in epilepsy. It is certainly inferior to the bromides. Ten drops of the tincture, or the one hundred and twentieth of a grain of atropia night and morning is the usual dose. This remedy appears to act more favorably in minor attacks. A combination of belladonna and one of the bromides is highly spoken of by Dr. Gowers.

Oxide of zinc is an old remedy for fits. From five to seven grains twice a day may be given for weeks and months. Few stomachs can bear this drug in larger doses.

Nitrite of amyl has lately been tried, but like so many other remedies for the cure of epilepsy, it has been undeservedly lauded.

Iodide of potassium, in conjunction with a bromide, is indicated in syphilitic epilepsy.

Iron and cod-liver oil are required in anaemia and general debility.

The possible removal of the exciting cause demands the first attention. Surgical interference may become necessary, as the incision of a cicatrix involving a sensory nerve, or the extirpation of tumors, etc.

Secondary epilepsy (Hughlings Jackson) resulting from organic disease of the nervous apparatus, calls for treatment of the primary affection.

Quite recently Dr. W. Alexander has strongly advocated ligation of the vertebral arteries for the arrest of epileptic seizures.

Chorea (St. Vitus' Dance).

Clinical History. The initial symptoms of this disorder are usually misunderstood by parents and teachers. Children, who are principally affected by it, are frequently chided and even punished for having contracted certain awkward habits and for indulging in silly behavior. These little patients let things drop from their hands, make all kinds of grimaces, continually shrug their shoulders, scribble when required to write, and exhibit a constant restlessness. Before long, however, these irregular movements and contortions are observed to be involuntary, and to become general and aggravated as the disorder progresses. Volitional acts always start the jerks, but they also come on spontaneously. In severe cases the whole body wriggles, and is forced to assume, with short respites, grotesque attitudes. Nearly every voluntary muscle may show incoordinate action. The eyes rotate, the tongue is suddenly thrust forward and is as suddenly withdrawn. Speech becomes affected, swallowing is difficult, strange sounds are uttered from spasmodic action of the laryngeal muscles, and the respiration is irregular.

The choreic movements usually begin in the hand or in the face or shoulder of one side, and then extend to other parts of the body. In hemichorea, as the name imports, the motor disturbances remain unilateral. Increase of sensibility is often noticed at the outset of the disorder, and later in its course muscular weakness and some

degree of mental obtuseness are observed. During sleep there is a cessation of the abnormal movements, but the patient is disturbed by starts that shorten his rest. It is remarkable that choreic persons never complain of a sense of fatigue caused by the incessant jactitations.

When the disorder is of a violent character it renders the patient completely helpless. He is unable to keep on his feet; he must be fed and dressed; deglutition is hindered, and speech is almost impossible. The constant friction of the elbows and knees against hard substances produces abrasions of the skin. Sometimes the jerking and tossing are so violent that the patient has to be fastened down to his bed.

Etiology. Chorea is a chronic disease. It is most frequently observed to attack children between the periods of the first dentition and puberty, and predominates in the female sex. A direct hereditary transmission of the malady cannot be shown to exist; but it must be assumed that a constitutional susceptibility predisposes to its development. Psychical disturbances, particularly fright, act as exciting causes. A similar mental influence operates in those singular cases which are ascribed to imitation. Chorea occurring during pregnancy or due to intestinal irritation, especially the presence of worms, is evidently of a reflex character. A causal relation between chorea and rheumatism is now generally conceded to obtain in a considerable number of cases.

Pathology. Neither anatomical nor experimental investigations have thus far led to any satisfactory results respecting the nature of chorea. Foyers of softening, probably due to capillary embolism, have been found in different parts of the brain, though mostly in the basal ganglia. In other instances the morbid changes involved the spinal cord, consisting of hyperplasia of the connective tissue. Pathological alterations affecting peripheral nerves are also mentioned. Some observers lay particular stress on the post-mortem evidences of endocarditis in connection with chorea. This concurrence throws much light upon the source of embolic softening and hemorrhage of the nerve centers which are sometimes found in persons who have died of chorea, and suggests a relationship between this disorder and rheumatism. The facts which speak in favor of a cerebral origin of chorea are the occasional localization of lesions in the basal ganglia, the occurrence of hemichorea and the mental hebitude.

Diagnosis. The symptomatology of chorea is of so marked a character that it is at once recognized. The tremor of paralysis agitans bears but a faint resemblance to choreic jerks. Certain diseases of the brain, especially tumors, occasionally give rise to choreiform movements; but the recognition of the primary disease will at once remove the uncertainty.

German authors group under the name of "chorea magna" a class of cases characterized by an irresistible motor impulse which leads to the exhibition of extraordinary involuntary movements. The "dancing mania," "tarantism" and "electric chorea," which prevailed from time to time in an epidemic form in Europe, belong to this category. Motor disturbances of an analogous and curious character are occasionally brought under notice. There is reason to believe that many of these morbid phenomena are allied to hysterical, maniacal or epileptic paroxysms; or, perhaps, depend upon a pathological condition somewhat resembling the psychical exaltation in trance, ecstasy, etc. A form of motor disturbance belonging to this species is known by the name of "saltatory cramp."

The following brief notes of a few cases which I had an opportunity to observe, will exemplify the character of these strange disorders:

A girl nine years of age had been subject for the last three years to "nervous attacks," (as her mother calls them), that present the following features: The child would suddenly begin to cry like an animal and then contort its body, throwing about the arms, kicking at the furniture, jumping in a "leap-frog" fashion, riding upon chairs, climbing on the table, rolling about on the floor, scratching the walls, endeavoring to tear its clothing and to perform many other unusual acts. During the paroxysms there is a constant discharge of saliva, the eyes are suffused and urine dribbles away. Consciousness remains intact. Any attempt to prevent the child from going through these antics increases their violence and duration.

A young man twenty-three years of age suffered at irregular periods from violent palpitations of the heart, attended by rapid rotatory movements of the head. These movements were not observed during sleep. In other respects he appeared to enjoy good health. Exploration of the chest detected no signs of organic disease of the heart. Under the use of valerianate of zinc, decided improvement of the symptoms was noticed, so that the patient did not present himself at the dispensary for the next three months. When I saw him again a new set of symptoms had made their appearance. He is now frequently attacked by an indescribable sensation in the cardiac region, which travels upward in the direction of the left shoulder, arm and hand. This is immediately succeeded by rhythmical movements of the affected extremity from right to left,

and accompanied by a sensation which the patient compares to electric shocks. At no time is there any loss of consciousness. The family history of the patient is not good. His oldest brother died in an insane asylum after having been afflicted with life-long epilepsy. A younger brother has a withered leg which dates from his early infancy. A sister suffers from hysterical convulsions. I forgot to mention that compression of the carotids momentarily arrests the abnormal movements. Thinking that this case might possibly be of an epileptic nature, I ordered a bromide with decided benefit.

It is hardly necessary to add that cases of this description totally differ from chorea.

The Prognosis of chorea is favorable. A fatal termination is the rare exception. Death may, however, follow from some serious lesion of the nerve centers, or from exhaustion brought on by the prolonged continuation of the disorder. Its average duration is about three months; but it may range from six weeks to six months.

Treatment. It is not easy to decide upon the efficacy of any particular remedy in the treatment of chorea. Mild cases require little medicine. The appearance of anæmia calls for ferruginous preparations. Intestinal irritation from worms or any other source must be met with the appropriate remedies. Choreic children should not be allowed to attend school. Quiet and rest I have found to abate the disorder. Cold sponging and the application of the galvanic current to the spine at the early stage of the malady, sometimes moderates the violence of the movements. Arsenic is a favorite remedy in chorea. It is usually given in the form of Fowler's solution. Sulphate of zinc and strychnia also enjoy the reputation of shortening the attack.

CHAPTER XIII.

HYSTERIA.

Etiology. Whilst pathological anatomy throws no light on the nature of hysteria, many an ingenious theory has been proposed to clear up the mass of singular and bizarre phenomena that characterize this protean malady. Clinical facts lead to the conclusion that hysterical persons suffer from an instability of the nervous system which constitutes the fruitful source of their manifold ailments. This neuropathic condition, or more specifically, this hysterical diathesis, greatly preponderates in the female sex. Heredity exercises a decided influence in favoring its development. It is easy to understand why the delicate and impressionable structure of the nervous apparatus in women should readily react in an undue manner to exciting causes which hardly affect the sterner sex. Hysterical symptoms in girls frequently make their first appearance at the period of pubescence. Of a similar influence is the recurrence of the menstrual molimen. Experience teaches that uterine and ovarian trouble, anæmia and chlorosis, not seldom lay the foundation of a life-long hysteria. Boys of a tender age sometimes exhibit its well-known phenomena. Considerable influence in establishing this malady must also be attributed to the injurious effects of mental excitement, especially those of a depressing nature, such as deep anxiety, secret sorrow, disappointment, harsh treatment, etc. The mistaken and ill-directed training of little girls who give early intimation of a disposition which betrays odd or morbid susceptibilities, is much to be blamed. It is alleged that the frivolities and artificial excitement in which females in affluent circumstances are apt to indulge, augment the number of hysterical patients; but women in humble walks of life are certainly not exempt.

Clinical History. Considering the wide range of the hysterical symptoms and their diversity, even in the same patient, it is a questionable undertaking to essay the description of a typical case of this disorder. It is more useful to point out those significant

phenomena which betray the existence of the hysterical diathesis; but it must be observed at the outset that the morbid manifestations are not distinguished by any intrinsic peculiarity; their true nature is rather recognized by the disproportion existing between their apparent intensity and their unsubstantial basis, and not less also by their association with other sets of symptoms, well known to every experienced physician.

Hyperæsthesia is, perhaps, one of the most frequent ailments of hysterical females. The muscular as well as the cutaneous sensibility is morbidly acute. Touch or pressure in many parts of the body elicits pain. The movements of the limbs are sometimes attended by such extreme pain that a patient cannot be persuaded to leave her bed or sofa. The head, the shoulders, the chest, the back and the abdominal walls appear to be highly sensitive, which suggests to the alarmed patient the existence of some serious internal disease. Sir Benjamin Brodie first drew attention to a form of joint affection simulating arthritis which occasionally develops in hysterical females.

Few hysterical females are exempt from some species of neuralgia. "Clavus hystericus" signifies an intense pain limited to a small spot along the sagittal suture. Intercostal pain is probably the most constant species of neuralgia in hysteria. Ovarialgia may acquire such a great intensity as to bring on a hysterical fit.

Uncomplicated anæsthesia of the left side of the body is peculiar to hysteria. The electro-cutaneous sensibility is at the same time much diminished. The anæsthesia sometimes shifts spontaneously. This change, according to recent experiments, or the "transference," as it is called, occasionally follows the application of certain metallic disks. Insensibility to pain is not seldom associated with the cutaneous anæsthesia.

The local spasms which so frequently harass the hysterical are of great diagnostic importance. The phrase "globus hystericus" expresses the sensation of a ball rising in the throat. It is produced by constriction of the pharynx and œsophagus, and causes difficulty of deglutition. Spasm of the glottis causes a choking sensation. Convulsive laughter, sobbing and crying, frequently terminate or may replace a hysterical fit. An incessant cough like the sound of a trumpet is known as the hysterical cough. Asthmatic attacks, hiccoughs, the eructation of gas from the stomach, movement of the gases in the intestines (borborygmus), vaginismus and vesical tenesmus, complete the list of these local spasms.

The gastro-intestinal disturbances of hysteria comprise disgust for certain articles of food in common use, disinclination for regular meals, or a raving appetite. Obstinate vomiting without an assignable cause is one of the most intractable symptoms of hysteria. This, and habitual constipation of the bowels, in hysterical females seem to baffle all the ordinary remedies.

Among the host of hysterical symptoms must also be mentioned epigastric pulsation, which may counterfeit aneurism. Menstrual irregularity is probably more frequently the effect than the cause of hysteria.

Hysterical Convulsions. Not every hysterical female is subject to hysterical convulsions, but a paroxysm is prone to develop under the influence of strong mental excitement. A hysterical fit may set in rapidly, though in many cases there is a brief prodromic stage characterized by a feeling of languor, epigastric uneasiness, a choking sensation, fluttering at the heart and vague pains in the limbs. The fit usually begins with a partial loss of consciousness, the patient flings herself on the bed or falls with some deliberation to the floor; frequently she screams or becomes noisy, which is kept up during the attack. Spasms of an unrhythmical character quickly supervene; the limbs are wildly thrown about, the eyes turned up or firmly closed, and various other grimaces of the face may be noticed. The hysterical fit does not always present such a violent and tumultuous character. Frequently the consciousness remains free, and the patient complains of severe headache and epigastric pain. When the spasmodic movements are limited to the hands and feet, they are usually in a state of tetanic contraction, being either firmly flexed or extended. Hysterical convulsions may be indefinitely prolonged. Their termination is usually announced by a loud escape of gas or air from the stomach, a shower of tears and a copious flow of limpid urine.

A physician who has once watched a hysterical fit would be inexcusable if he should confound it with an epileptic seizure. If the epileptic utters a shrill cry it is only at the onset of the attack. His loss of consciousness is complete and he falls to the ground headlong and unprepared. Epileptic spasms present the typical characters of tonic and clonic contractions. There is biting of the tongue, bloody, frothy mucus at the mouth, the face presents a hideous appearance, the pupils are usually dilated, and the whole attack is of short duration. All these characteristic clinical features

are wanting in the hysterical fit. Still a case now and then comes under notice in which the hysterical and epileptic elements seem to be blended. French authors draw frightful pictures of these so-called cases of "hystero-epilepsy."

Hysterical Paralysis. Motor paralysis is the most serious symptom of hysteria. Briquet observed various forms of paralysis in a large number of his cases. The paralysis may assume the hemiplegic, the paraplegic and the peripheral type. Hysterical aphonia is due to paralysis of some of the muscles of the vocal cords. Paralysis of the bladder is also frequently observed. Electrical exploration affords much assistance in recognizing the hysterical character of these motor disturbances. The electro-muscular contractility is usually found intact, whilst the electro-cutaneous sensibility is much diminished. It is also a curious fact in the history of hysterical paralysis that the muscular power is sometimes suddenly restored without an apparent cause, and as unexpectedly again impaired.

Mental Disorders of Hysteria. Psychical disturbances are seldom wanting in marked cases of hysteria. It is particularly the sphere of emotional life, the sensibilities, the mood, temper and disposition which manifest a morbid tendency. The lower fundamental elements of mental activity seem to exercise a controlling influence and to react in an abnormal manner. Slight impressions produce an exaggerated effect; the propensities, the inclinations and the will are perverted; there are an obstinacy and waywardness which, to the inexperienced, appear unaccountable. The undue mobility of the feelings is exhibited in the sudden transitions from gayety to sadness. There is a passiveness to the play of fancy; singular likes and dislikes; sometimes decided apathy and stolid indifference, or a morbid desire to attract attention and to create sympathy and interest. Hysterical persons who are more or less affected in this manner are an enigma to their friends and acquaintances, and a plague and a source of mortification to their families. The higher grade of such psychical abnormities, which is fortunately not common, may assume the character of moral obliquity, or terminate in the development of insanity. Many are the transformations of the hysterical frame of mind. Weir Mitchell has published a series of remarkable and instructive cases, illustrating the diversified and hidden character of hysterical aberrations. On the other hand, every strange and

inexplicable phenomenon of a neuropathic nature is liable to be labelled as hysteria, though nothing is gained by the liberal use of this elastic term.

Diagnosis and Prognosis. Little of any importance remains to be said under the head of diagnosis. There is one observation, however, which appears to be pertinent in this connection. Hysterical people, like ordinary mortals, are subject to diseases of the nervous system which stand in no relation to hysteria, and it must be borne in mind that in nervous females the symptoms pertaining to grave affections are apt to assume a deceptive character. Hysteria is certainly not a serious malady, but it is one of the most distressing inflictions to which the female sex is liable, and to deal with it successfully requires a peculiar tact on the part of the physician which not every one has at his command.

Treatment. A protest must be entered against the cruel indifference with which the ever-returning ills and ailments of the hysterical are generally regarded. The physician who shares in this error is certainly blamable. It is true, hysterical women are exceedingly troublesome patients, and often try the equanimity of the medical attendant to the utmost; but if he succeeds in gaining their confidence, which can be best accomplished by an unaffected sympathy combined with firmness, he will have comparatively an easy task before him. Banter and ridicule are entirely out of place. The opposite course of an undue display of anxiety and the slavish readiness to satisfy every whim, which fond mothers are apt to manifest, must equally be deprecated.

Strict inquiry should be instituted concerning the uterine functions, but too much should not be made of slight disturbances.

The digestive functions require attention. Better results are obtained if the patient can be weaned from the morbid anxiety respecting the gastric troubles, than from the reputed anti-dyspeptic remedies. A course of some of the mild mineral waters suits the torpid state of the bowels.

Treatment is sometimes very satisfactory where hysteria is attended by anæmia or chlorosis. Blaud's pills, which are composed of equal parts of sulphate of iron and potassium carbonate, are highly recommended by Niemayer. They should be given in large doses and for a lengthy period. Sea-bathing and the electric bath may also prove of service.

Women of a plethoric habit require an opposite course of treatment. The sensations of fullness of the head and heaviness of the limbs are sometimes relieved by leeches to the head or cupping over the spine. Green tea and coffee should be prohibited.

When there exists a superabundance of fat of a flabby kind it is advisable to reduce its bulk by a spare diet, and then gradually to improve the general nutrition by a more generous diet, which should at first be principally composed of milk.

Anti-Hysterical Remedies. Formerly when the diagnosis of hysteria was made, it implied assafœtida and valerian, now it means the bromides. Valerian is the least objectionable when something has to be done against trifling and evanescent symptoms. The bromide is undoubtedly a capital remedy, independent of its calming influence, as it possesses the additional advantage of superseding the use of narcotics. The latter should be sparingly given, or not at all, for fear of inducing a vicious habit. For the same reason it is unadvisable to be liberal with wine or brandy, though the evident debility of many hysterical persons seems to call for stimulants.

Some of the popular measures for cutting short a hysterical fit are frequently quite effective, but stuffing the mouth with salt or throwing a pailful of water over the head of the patient should not have the sanction of the physician. Violent measures are at any rate not required in an affection which ceases of its own accord and is unattended by danger. Compression of the ovaries, by applying the closed hand firmly to the groin, sometimes succeeds in arresting the convulsions. Hysterical spasms, which are attended by pain usually in the epigastric region, can be promptly relieved by a hypodermic injection of morphia.

Good results may be expected from the electrical treatment in the different forms of hysterical paralysis. The interrupted and constant currents should both be tried. Rapid improvement is occasionally witnessed from the use of the electric brush in hysterical anæsthesia. Hyperæsthesia is relieved by weak galvanic currents.

Spinal Irritation.

There was a time when the disorder known as spinal irritation was thought to be of such frequent occurrence that extravagant notions were entertained of its importance as the common pathological factor of manifold forms of disease. A reaction took place when it was

found that spinal tenderness attends many affections of which it forms but an accessory symptom. Moreover, the same symptom is so frequently observed in that protean malady, hysteria, that the belief in the existence of spinal irritation as an independent disorder is generally abandoned by neurologists. But on the other hand it is hardly permissible to label every obscure nervous disorder with the convenient title, hysteria. It is equally unsatisfactory to theorize upon the possibility of a hyperæmic or anæmic condition of the cord as the anatomical basis of the so-called spinal irritation. In the meantime the physician in actual practice cannot ignore the fact that he has frequently to face groups of symptoms which appear to stand in no other relation to each other than their co-existence with spinal tenderness. The circumstance that eccentric pains and an exalted sensibility constitute the most constant concomitants of the sore vertebræ, tells strongly in favor of the assumption that the phrase spinal irritation implies a real disorder, at least of clinical importance.

Patients are often unaware of the existence of this spinal tenderness until it is elicited by pressing the fingers against some of the spinous processes, or passing a hot sponge along the spinal column. The tender points (points apophysaires) are usually limited to a few vertebræ in the cervical or dorsal, and less frequently in the lumbar regions. In severe cases the whole spine appears to be sore to the touch. This exalted sensibility not seldom occupies large areas of the cutaneous surface.

Neuralgic pains are felt in different parts of the body. Their locality frequently corresponds to the distribution of sensory fibres that proceed from the tender portions of the spine. This explains the eccentric character of the pains.

Local spasms, especially of the muscles of the lower extremities, are quite frequent. A crampy condition of the muscles of the neck gives rise to a distressing sensation of choking. A harassing cough and occasional attacks of dyspnœa which probably depend upon contractions of the laryngeal and respiratory muscles, cause much alarm to the patient.

Additional symptoms more or less frequently attend the spinal tenderness which are as annoying to the patient as they are puzzling to the medical attendant. They principally consist of irritation of the bladder and vesical tenesmus; palpitation, or rather a sensation of fluttering in the region of the heart; nausea, eructations and

occasional vomiting; epigastric pulsation; faintness, vertigo, and a chilly feeling, alternating with hot flushing of the face. Continuous loss of sleep is a very distressing symptom in aggravated cases, causing a feeling of languor and depression, so that patients cannot be persuaded to leave their bed or lounge.

Etiology. The frequent association of spinal irritation with hysteria points to a similarity of causative influences. Excessive physical exertion trying to the spine probably acts in many instances as an exciting cause. Austie says, "I believe the starting point of the disorder will very often be found in some strain or blow to the back."

An obstinate case of spinal irritation some time ago came under my notice, which the young female patient attributed to the wearing of a shoulder brace (weighing nearly thirty pounds) for supposed curvature of the spine.

Much stress is laid by some writers on the deleterious effects of sexual excesses, especially onanism, in developing the malady. It is also surmised that unconscious sexual irritation in women of pure mind exerts a similar morbid influence.

Diagnosis. The diagnosis of spinal irritation requires considerable caution. The tenderness of the vertebræ must be distinguished from the pain attending organic affections of the spinal cord and disease of the vertebræ. Mistakes are more frequently committed in misinterpreting the eccentric pains which accompany obscure affections of the thoracic and abdominal viscera. The existence of paralysis excludes spinal irritation. The pain of neuralgia, unlike that of spinal irritation, is limited to the course of the affected nerve; it is unilateral and not shifting. The pain of muscular rheumatism is increased by movement and pressure, and is of a diffused character.

The close relationship existing between spinal irritation and hysteria is well expressed by Dr. Radcliffe. "Spinal irritation," he says, "is hysteria plus spinal irritation." It may be here remarked in passing, that hysteria admits of such an expansive definition that this malady always obtrudes itself upon the attention whenever ill-defined groups of nervous symptoms are encountered.

Prognosis. Although spinal irritation is a chronic disorder, exceedingly fluctuating in the severity of its symptoms, hard to deal with, and prone to relapses after the most encouraging improvement, it notwithstanding tends to recovery.

Treatment. The unsatisfactory results of the usual therapeutical measures directed against a class of symptoms of an obscure and shifting nature, leave much scope to the tact and judgment of the physician. As spinal irritation is a disorder frequently witnessed in females who have undergone much hardship in life, physical or mental, it is advisable to invigorate the general system by means of the approved tonics, iron, quinia, strychnia and cod-liver oil. To assist the effect of these remedies, a generous diet, rest and quiet must be enjoined. Blistering of the tender vertebræ is universally recommended. I have found great benefit from the application of the electric brush to the hyperæsthetic skin. All observers are agreed that alcoholic stimulants exert a decided beneficial influence in this disorder. Unfortunately the dangerous fascination of all kinds of spirituous liquors is a great drawback to their remedial virtues. The refreshing effect of general faradization is appreciated by most patients suffering from the malady.

Neurasthenia.

The late Dr. Beard of New York described, under the name of neurasthenia, a functional affection of the nervous system which he alleged to be extremely common among the adult male population of the United States. He says: "One reason why neurasthenia has been so long neglected is that the symptoms are in some instances so subtle and difficult of analysis and classification. One who has never seen and carefully examined a large number of cases of this disease, would not believe it possible that it could manifest itself in so many different ways." Erb devotes a short chapter to the discussion of this disorder, although he does not claim for it the multiplicity of symptoms which Dr. Beard has enumerated.

Nearly all the morbid phenomena which are said to characterize neurasthenia are usually grouped under different affections, chiefly hysteria, spinal irritation and hypochondriasis. It will hardly be disputed that many vague and ill-defined symptoms come frequently under notice which cannot be satisfactorily referred to disorders of such uncertain pathology and inconstancy of clinical features. Experience fully sustains what physiological teaching leads us to expect, that numerous and diversified disorders of the nervous system are directly traceable to the depressing influences of physical over-exertion and mental strain. Whatever other causes may be assumed to favor their occurrence, and among these, seminal losses

stand pre-eminent, it is but fair to consider nervous exhaustion a fruitful source of manifold disturbances. The practical importance of recognizing such a condition, under the many disguises it may assume, is apparent.

Clinical History. Among the great array of subjective symptoms, variable and fluctuating in character, even in the same patient, there is none more constant and conspicuous than a feeling of muscular weakness and unusual tiredness. Of hardly less frequency is the existence of lumbar and dorsal pain, which often radiates to the occiput and vertex. Sometimes patients complain of a distressing feeling of constriction around the chest, or of a choky sensation, dyspnœa and cardiac excitement, associated with epigastric uneasiness and annoying eructations. The general sensibility is heightened, and gives rise to shifting pains of a neuralgic character in different parts of the body. Micturition and defecation may cause much discomfort. The sexual function, in many cases, is enfeebled. Young men in whom the latter symptom is associated with spermatorrhœa or nocturnal emissions, evince much apprehension of becoming the victims of serious spinal disease, or of being threatened with impotence and paralysis. Real paralysis does not occur, although neurasthenic persons are incapable of sustained muscular efforts, and are often troubled with the sensation of numbness, formication and coldness in the lower extremities. Under these circumstances a hypochondriac disposition is liable to develop.

Neurasthenia is sometimes rapidly established in persons of a hereditary tendency to neurotic affections, but generally its progress is slow.

Diagnosis. It is above all necessary in the diagnosis of this disorder to inquire into the previous history of the patient, his habits and present pursuits. A thorough examination and sifting of the symptoms must be instituted, as they may be easily mistaken for those of some serious organic disease, especially of the spinal cord.

Treatment. Hygienic measures are of the first importance in the management of every case of neurasthenia. The patient must change that mode of life which led to brain exhaustion and spinal irritability. He may require absolute rest and quiet, or be benefited by exercise which does not cause fatigue. The recuperative influence of mountain air or a visit to the sea-shore should not be neglected. Sufficient

sleep, substantial but easily digested food, and a judicious course of tonic remedies, especially iron, quinia and strychnia, complete the constitutional treatment.

Much benefit is derived from the frequent sponging of the spine with sea salt water and friction with a rough towel. The restoration of the muscular vigor should be promoted by massage and general faradization. Decided relief of the spinal pain is sometimes obtained from the application of ether spray.

Hypochondriasis.

This disorder betrays an affinity to melancholia, inasmuch as the alteration common to both is characterized by a depressed condition of the mind and an excessive feeling of anxiety and apprehension. It would, nevertheless, be erroneous to class hypochrondriasis with insanity, for, although aggravated cases of the former exhibit much psychical disturbance, still the intelligence remains clear in the main, and no hallucinations and delusions develop. The essential clinical feature of hypochondriasis is a morbid disposition to fix the attention on slight ailments, which are magnified and falsely interpreted by the patient. The anomalous sensations of which he constantly complains are undoubtedly real, they absorb his thoughts, leave him no rest, and render him sad, morose and peevish. In addition to these vague and indistinct feelings, which probably have their seat in the abdominal viscera, there are other symptoms of a more palpable nature. They principally consist of an uneasiness in the epigastrium and a burning sensation in the umbilical region. Flatulence, disordered bowels, palpitation of the heart, and flushes of heat in the face occur less frequently. Each of these morbid sensations is a source of great anxiety to the patient. He watches, studies and bewails them. By-and-bye he locates them in a particular organ or a certain part of the body, and is convinced that he is the victim of a serious disease. The shifting character of these morbid sensations is probably the reason why hypochondriacs imagine they are successively affected by a variety of diseases. Now it is the stomach, then the liver, next the heart, the lungs, the bowels, the bladder or spinal marrow. This change in the situation of the fancied disorder is sometimes suggested by the names of diseases about which they hear or read, or is prompted by an odd and fantastic notion concerning the nature of their troubles. Hypochondriacs continually change their medical advisers and are

voracious consumers of drugs. Many are in fear of losing their sexual powers, and if ever they had syphilis, or imagine they had, they become the victims of syphilophobia.

Etiology. Hypochondriasis chiefly affects men, but typical examples of the malady are occasionally observed in women. It is always a chronic affection, though it rarely endangers life.

Treatment. Although hypochondriac people are exceedingly fond of taking medicines and often declare they are benefited by them, yet they never will admit that they are cured. There is no use to direct treatment against any special symptom, for ten others will take its place. Attention should nevertheless be paid to the digestive organs, which are frequently disordered. Vegetable tonics, such as calisaya bark, cascarilla, columbo and gentian, with the addition of a mineral acid, answer very well. This should be assisted by an occasional pill of aloes in combination with nux vomica, or some bitter water, when hemorrhoids exist. In fact the torpidity of the bowels is a standing complaint of these patients. An active life, devoted to some regular occupation which involves considerable physical exertion, is often of greater service than all medication. Good results may also be obtained from the so-called "moral therapeutics," which consists in the effort to wean the patient from his gloomy thoughts and brooding over his fancied ailments. According to circumstances he may be urged to enter a political career, or take an interest in a popular philanthropic cause; attend to vestry meetings, engage in a scientific pursuit, or cultivate one of the fine arts. Extensive travelling, which breaks in upon the monotonous routine of life, is sometimes beneficial. Strategy has in some instances proved successful.

Griesinger quotes the case of a young woman who fancied that her intestines protruded through the partly-opened abdominal walls. Her physician did not dispute her assertion, but remarked that it is not unusual in the event that the abdominal muscles are weak for the intestines to come to the surface. He ordered an apparatus to support the parts, and he had the satisfaction not only to cure her of her false idea, but also relieved the obstinate constipation of the bowels from which she had suffered for a long period.

The General Paralysis of the Insane (Paralytic Dementia).

A sad interest attaches to this disease which, in popular language, has received the ominous designation of "softening of the brain." It attacks men in the prime of life, rapidly destroying in its progressive course both body and mind. A singular combination of motor and psychical disturbances characterizes the typical form of this affection, which is traceable to marked lesions of the brain and its membranes.

Clinical History. It is convenient to divide the clinical history of paralytic dementia into three stages: 1, the premonitory stage; 2, the stage of acute mania; and 3, the stage of chronic dementia and muscular prostration.

The Premonitory Stage. Enfeeblement of the mind and alteration of character, habits and inclinations, may for an indefinite period constitute the only indications of the disease. The mental defect principally manifests itself by forgetfulness, a lowered intellectual capacity, and oscillation of the will. There is, besides, a laxity of moral behavior which is not usual with the patient. He indulges in excesses, visits disreputable houses, passes much of his time in low drinking shops and spends his money freely. Such a patient can hardly be said to be insane, but he certainly is drifting into it. The manner in which this moral deterioration displays itself is influenced by the social position and pursuits of the patient. If he is a merchant or a professional man, he becomes careless of his promises, neglects his appointments, mislays important papers, gives orders that derange his business and forgets them. The sedate *pater familias* raises scandal by his unbecoming conduct, which he takes little pains to conceal or to defend. Another makes expensive presents to persons he knows and does not know, or engages in foolish enterprises that involve heavy pecuniary losses. The friends and acquaintances of such patients are puzzled to account for this change of character. During this stage of development symptoms of a different order begin to make their appearance. Headache and vertigo are much complained of, and fainting fits, due to cerebral congestion, become alarmingly frequent. Very commonly, some disturbance of speech is noticeable, as if the tongue were too heavy. Words are articulated with difficulty, attended by trembling of the upper lips and quivering of facial muscles, like in a person who attempts to speak under a great state

of excitement. The gait is somewhat stiff and awkward, the pupils are unequal and occasionally there is squinting. Gradually a form of insanity develops, which is distinguished by delusions of grandeur and exaltation. Patients boast of their wealth and distinction, their muscular prowess and elevation of spirits. This stage is sometimes ushered in by paroxysms of maniacal excitement, usually of short duration. Instead of this expansive state of the mind there is occasionally witnessed a depressed mental condition of a melancholic or a hypochondriac nature; but, invariably, the final stage in all cases is that of hopeless dementia. Parallel with the progressive obscuration of the intelligence, the extent and intensity of the paretic condition steadily increases until the patient is reduced to an utter wreck of his former self. He no longer recognizes familiar faces, nothing attracts his attention or excites his interest, an unintelligible stutter replaces speech, the muscular weakness renders him completely helpless, he cannot walk without the assistance of the attendants, and he must be fed, dressed and cleansed like a child. Although the appetite is fairly good, and sometimes even voracious, still the general nutrition of the body suffers. Paralytics may linger on in this miserable condition for a considerable time, but many of them are carried off by intercurrent diseases or succumb to the frequent recurrence of their convulsive or apoplectiform attacks. Death by suffocation is not uncommonly caused from morsels of food becoming lodged in the œsophagus, due to paralysis of the tongue and pharynx.

A few of the more important symptoms require special consideration.

The delusions of exaltation are not peculiar to general paralysis, but they are witnessed in this disease with exceptional frequency, and distinguished by their extreme absurdity, which overleaps all bounds of the possible. An ordinary maniac may fancy that he is a king, a millionnaire, an apostle; he acts the assumed rôle and maintains his pretensions against all comers; but the demented paralytic declares in one breath that he is the king of kings, the possessor of millions, Napoleon, the Pope, Bismarck, and a tight-rope dancer. He is never struck by the incongruity of these fictions of his mind, personates them but indifferently, and can be easily persuaded to drop them, though only to take up others just as senseless and ridiculous. Even when the delusions betray a melancholic basis they partake of the absurd. A patient will say that he only measures

one inch in height, that he is three-cornered, that he was buried yesterday. The delusions in the female patient turn more upon matters that are congenial to her sex. She boasts of possessing innumerable silk dresses, has drawers full of the richest lace handkerchiefs, is confined every day with twins, and the like extravagances.

The maniacal paroxysms of the demented paralytic are episodical, exhibiting sometimes such a violence that patients in their blind, imbecile fury attack every one within their reach. They are exceedingly troublesome inmates of hospitals; they are noisy, filthy, mischievous and destructive. During the calm intervals, however, they are easily controlled if indulgence be shown to their silly but harmless fancies.

Apoplectiform and epileptoid seizures occur at irregular periods during the whole course of the disease. The former are distinguished from apoplectic attacks resulting from cerebral hemorrhage, by the circumstance that the subsequent hemiplegia disappears quickly or is hardly perceptible. The convulsive seizures may bear the closest resemblance to genuine epilepsy, but more frequently there is no complete loss of consciousness, and the spasms are not general. Patients usually recover from these attacks, though they constantly lose ground after each of them.

When the paralytic is visited in the insane asylum, to which he usually finds his way at some time or another, he can be easily recognized by his bloated face and idiotic expression. He is entirely oblivious of his wretched condition, and appears contented and happy. On being asked how he feels he will complacently answer that he never felt stronger and better in his life. He will probably regale his visitors with an account of the gold mines he owns, the splendid horses and carriages which are at his command, the palatial mansion in which he resides, and perhaps present the medical attendants and nurses as his servants and lackeys. He is continually writing letters to bankers and other people, though he does not wonder why he gets no replies.

Before the last stage of imbecility and paralysis is reached it is not very rare to witness repetitions of remarkable improvement of all the symptoms. This improvement is sometimes so decided and prolonged that the family or friends of the patient are inclined to remove him from the hospital, under the impression that complete recovery has taken place. Such a patient may again be capable of

attending to the ordinary transactions of life and enjoy the liberty and comforts of home. It may cause much embarrassment to the alienist, when called upon for his opinion whether such a person is competent to enter into engagements which involve serious responsibilities. Experience has taught that relapses, in cases of this kind, are the rule, and that such invalids are liable to break down again whenever they attempt the management of complicated affairs.

Diagnosis. Familiarity with the mode of development and the symptomatology of a typical case of paralytic dementia renders the diagnosis of this disease comparatively easy. Its distinction from allied forms of insanity has already been mentioned. There may arise some difficulty in distinguishing the disease from certain cases of cerebral syphilis, but the peculiarities of the clinical features of the former will help to remove the doubt.

Prognosis. The average duration of the disease is about three years. The prognosis is exceedingly unfavorable. A few cases of recovery are on record, but thousands die yearly of this terrible disease in our hospitals.

Etiology. Heredity is one of the special predisposing causes of paralytic dementia, but this influence is less marked than in other varieties of insanity. It affects persons between the ages of forty and fifty-five years, which shows that its development is favored by the strains to which the brain is exposed during the most active period of life. The greater frequency of the disease in men than in women is in the proportion of seven to one. Among the exciting causes are mentioned sexual excesses and alcoholism; it is probable, however, that the existence of a constitutional vulnerability of the brain offers in these cases a diminished resistance to these morbific influences.

Anatomical Changes. The post-mortem appearances indicate the existence of a chronic inflammatory affection, involving the meninges and the substance of the brain, and also to some extent the spinal cord. This pathological condition is usually limited to the pia mater and cortex of the frontal lobes and adjacent regions. The thickness of the pia is most marked along the course of the large bloodvessels. The dura mater is commonly involved in the morbid process and may give rise to hemorrhagic pachymeningitis. Microscopical appearances embrace changes of the bloodvessels, dilatation of the

peri-vascular canals and emigration of blood corpuscles. The anatomical alterations affecting the brain consist of sclerosis, atrophy and degeneration of the nerve elements. Analogous changes are occasionally found in the spinal cord. Its membranes in some places show the signs of chronic inflammation. The posterior or lateral columns may be alone affected.

Treatment. In the face of the exceeding grave nature of general paralysis and its fatal tendency, therapeutic measures hold out but the faintest hope to accomplish anything. The more urgent is it, therefore, to recognize the disease at its outset, not only for the purpose of saving the patient from the debilitating influence of the excesses that hasten its development, but also to be able at an early date to apprise his family or his friends of the risk he runs in effecting his pecuniary ruin, loss of character and reputation. Alcoholic stimulants are particularly obnoxious, though at a later period they are of service. The potassium iodide should have a fair trial. Digitalis is the remedy which stands in highest repute for calming the attacks of maniacal excitement. It is given in doses of fifteen to thirty minims of the tincture every three or four hours. The fluid extract of conium in ten to twenty drop doses is also highly recommended. A ferruginous preparation, especially the tincture of the chloride of iron, is sometimes of great benefit after the state of excitement has abated. The epileptiform seizures must be controlled by the bromides.

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